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CIVIL ENGINEERING.

Description of the Great Britain Iron Steam Ship, with Screw Propeller; with an Account of the Trial Voyages. *By* THOMAS RICHARD GUPPY, ESQ., C. E.

[From the Proceedings of the Institution of Civil Engineers.]

The Great Western Steam Ship Company originated with a few directors and proprietors in the Great Western Railway Company, who entertained the idea, that, on the completion of the railway from London to Bristol, a direct line of communication, by means of steamboats, to New York, as the focal point of the New World, might be established with advantage.

Hitherto, attention had been directed to the south-western harbors of Ireland, and the nearest ports in America, as the extreme distance between which steamboats of the greatest power then supposed to be practicable, would be enabled to carry a sufficient quantity of coal for the voyage; but this company, placing confidence in the opinion of Mr. I. K. Brunel (their engineer,) ventured to build the *Great Western*, a steamer exceeding in size any that had previously been constructed, and with engines of so much greater power, that the predictions of many experienced and scientific men were unfavorable to the project.

The *Great Western* did, however, fulfil the expectations entertained of her by her projectors, in all respects, except in that, like many other moderate-sized steam vessels, so large a part was occupied by the machinery, relatively to that which could be appropriated to pas-

sengers and goods, the deficiency of space was soon found to operate disadvantageously in a pecuniary point of view.

At first it was intended that their second ship should be of timber, but the superior advantage which the introduction of iron appeared to hold out, induced a very careful comparison, and an investigation into the state of some small steam vessels already constructed of this material, and the result was the abandonment of the previous resolution.

As no example of an iron steam-ship of sufficient size existed, on which to base any calculation of the thickness of the iron to be employed in its construction, or of the disposition of the material, in order to obtain the greatest relative degree of strength, much consideration was requisite, and it became necessary to organize an establishment for building iron instead of wooden ships, before the keel of the new vessel was laid.

The principal dimensions of the hull of the *Great Britain*, are—

	Ft.	In.
Length of keel, ...	289	0
Length aloft, ...	322	0
Main breadth, ...	50	6
Depth of hold, ...	32	6

The tonnage, according to the usual mode of builders' measurement, is therefore, 3,444 tons.

The weight of iron used in the hull is about 1040 tons; which is equal to an average thickness of 2¼ inches.

The weight of the wood-work in the decks, fittings, &c., is about 370 tons.

And the weight of the engines and boilers (exclusive of the water) is 520 tons.

The total weight, therefore, is 1,930 tons; which, at a draft of water of 10 feet 6 inches forward, and 13 feet 7 inches aft, corresponds exactly with the calculation of the displacement of the hull, which is as follows:—

Draft.	Fore Body.	After Body.	Total.
Feet.	Tons.	Tons.	Tons.
12	1053	851	1904
14	1315	1099	2414
16	1594	1386	2980
18	1904	1714	3618

She will therefore be able to take 1000 tons of coal, and 1000 tons of measurement goods, weighing perhaps 400 tons, at a draft of 17 feet forward, and 17 feet 6 inches aft.

The keel plate consists of plates ⅞ths of an inch in thickness, by 20 inches wide, which were welded into lengths of 50 feet to 60 feet, and these lengths were joined together, by very accurately made scarphs, 1 foot 6 inches in length, and riveted all over, at distances of 4½ inches apart.

The end pieces of the keel, which are more liable to touch the ground, are full 1 inch in thickness.

The stem is 12 inches deep at the forefoot, by 5 inches thick, and at the 8 feet water mark, it is 16 inches by 2½ inches; thence it diminishes gradually to 12 inches by 1½ inch. It is welded in one piece 18 feet long.

The ribs or frame are formed principally of angle iron, 6 inches by 3½ inches by ⅜ths inch, at distances of 18 inches from centre to centre, but inclining gradually to 24 inches at the extremities, where, also, angle iron, 6 inches by 2½ inches, and 4 inches by 3 inches, is used.

In that part of the body of the ship which is occupied by the engines, the ribs are doubled, by having a similar angle iron riveted to them, with the web inside, or, as it is termed, "reversed."

The outside plating commences with plates 6 feet to 6 feet 6 inches long, and 3 feet wide, by $\frac{11}{16}$ths inch thick; of these plates there are four courses; these are followed by several courses of ⅜ths inch thick, which is the strength of the whole of the immersed part, up to the deep load water line.

Above that height the same thickness is preserved amidships, but it is gradually reduced to ⅜ths inch thick quite high up, and at the extremities, with a view to lighten them.

The longitudinal floor sleepers are ten in number; they are 3 feet 3 inches in depth, and ½ inch and $\frac{7}{16}$ths inch thick.

The middle sleepers extend throughout the length of the vessel; those on the sides are level on their upper surface, and consequently are terminated by the rising of the bottom of the ship.

These sleepers are tied to the bottom, and are preserved in their vertical position by inverted curves of strong angle iron, which are riveted to the ribs and also up their sides.

Along the upper edge of each, there is an angle iron, and over the whole is riveted an iron deck ⅜ths inch in thickness.

There are two bilge keels, consisting of a middle plate, 1¼ inch thick, and two angle irons, 5 inches each way by 1 inch thick.

These bilge keels are 110 feet long, and their under edges are on the same horizontal level with the under side of the keel, so that in docking the ship, if long baulks of timber are extended across the dock by way of blocks, the weight of the body of the ship (where the boilers and machinery are placed,) is supported at given parallel distances on both sides of the keel, all risk of straining it, or the machinery, is avoided, and the vessel is not obliged, in the usual manner, to rest upon her keel, until the bilge shores can be got under.

The upper cargo deck forward is made of plate iron, $\frac{5}{16}$ths inch thick in the middle, and $\frac{9}{16}$ths inch thick round the sides; it is riveted together throughout, as well as to the iron deck beams, and to the sides of the vessel.

The main deck is made of pine timber 5 inches thick, and the planks are cross-bolted at distances of 4 feet apart.

As this deck is situated on the load floatation plane of the vessel, where transverse stiffness is of more importance than longitudinal strength, the planks are placed athwartships, and their extremities firmly bolted down, through two longitudinal stringers of Baltic tim-

ber, to the shelf plates which are 3 feet wide by five-eights of an inch thick, and are very securely fixed to the sides.

The middle or promenade deck is also of pine timber 4 inches thick, placed lengthwise of the ship; it has also strong iron shelf-plates 3 feet wide by ½ inch thick, and Baltic stringers to attach it to the side of the ship.

The upper deck is of red pine timber, and is also placed lengthwise. As the sides of the vessel at this height, and also this deck, may be considered as the truss, which is to resist longitudinal deflection, or drooping of the extremities, the outside plates are there ½ inch thick, and they have been strengthened by an outside moulding-iron strap, 6 inches by 1 inch, and by additional straps of iron 7 inches by 1 inch, welded into lengths of 60 feet, and riveted to the inner sides of the upper line of plates.

The shelf-plate of the deck is 3 feet wide by ½ inch thick, and upon this, outside of the water-way plank, which is 4½ inches thick, there is a course or tie of Baltic pine timber 340 inches in section, carefully scarphed and securely bolted to the ribs, and to the shelf-plate, throughout the length of the ship. There are three rows of timber pillars, or stauncheons, which are fixed to the bottom of the ship, passing up between longitudinal ties at each deck, and are secured to the upper one.

The beams of all these decks are made of angle iron, 6 inches by 3½ inches by ½ inch, and their ends are bent down, and riveted to the ribs on each side.

Upon them, the shelf-plates before mentioned are riveted, and thus form a horizontal band 3 feet wide at each deck.

A crutch or strut is introduced at each end of nearly every deck beam, which is riveted to it, and to the ribs at about 3 feet from the angle of junction.

One of the most important improvements which has recently been introduced in the construction of vessels (particularly those of iron,) is the water-tight bulkhead; as in the greater number of cases, when an injury may be sustained in one compartment only, it may absolutely preserve a vessel from sinking; several instances of this have already occurred, and even where it may not suffice for this purpose, it at least separates the leaky and injured from the secure parts, and gives time either to attempt to stop the leak, or to make other preparations.

In iron vessels, these bulkheads can be rendered much more effectual than in wooden ones, by their exact contact with the bottom and sides, while at the same time they form admirable ties and stiffeners.

In the *Great Britain* there are five such bulkheads.

The first separates the forecastle from the forward passengers' cabin and the hold, and as it is in the forepart of a vessel that injury is most likely to be sustained, this partition is made particularly strong and secure.

The next bulkhead divides the forward cabin from the engine room or more properly, from the fore-hold for the coal and the stokers, at the forward end of the boilers.

The third bulkhead is abaft the engine-room, but in this, there is necessarily a hole for the screw-shaft to pass through; this is secured by a well-fitted collar, and there is also a door, which is so arranged as to be shut and bolted quickly.

These three bulkheads pass up to the upper deck; there are also two others; one separating the after coal-hold from the after cargo-hold, and another nearly at the stern; both these terminate under the saloon deck.

The minute detail of the construction of the hull of the vessel would be too voluminous to be given here, and it would be unnecessary, as it will shortly be published. It is better, therefore, to proceed to describe the action of the screw propeller, which has now become an object of such deep interest to all who are engaged in marine engineering; and to the machinery by which it is to be put in motion.

At an early stage in the construction of the *Great Britain*, but not until her sides had assumed the form adapted for paddle wheels, the small steamer *Archimedes*, belonging to the Company owning the patent of Mr. F. P. Smith for the application of the Archimedean screw, visited Bristol, and amongst other parties invited to make an excursion to the Holmes, on board of her, were some of the Directors of the Great Western Steam-ship Company.

The performance of the screw on that occasion, induced the author to request permission of Mr. Smith and Captain E. Chappell, R. N., who was officially appointed by the Admiralty to report upon her, to proceed in her to Liverpool.

On the passage, enough rough weather was encountered to show that the screw possessed several good points, and was not so absolutely impracticable as had been asserted; and although far from venturing to give a decided opinion, on the author's return, he wrote such a letter to the Board of Directors as induced them, after some days of deliberation, to decide upon suspending, during three months, the progress of the machinery for paddles, and also of that part of the vessel which might be affected by the change, to call upon Mr. Brunel during that period to investigate the subject.

At the end of the proposed delay, the report which Mr. Brunel made was so favorable, that, undaunted by the novelty and vastness of the experiment, the Directors resolved to adopt this mode of propulsion, of the success of which they have now such cause of congratulation.

From that period, until it became necessary to decide on the exact form of screw to be used, all possible means were taken, by experiment and observation, to arrive at the best shape and angle of inclination of the blades, or as it is commonly called "the pitch."

Amongst others, the proprietors of Mr. Smith's patent liberally lent the *Archimedes* to the Great Western Steam-ship Company, for a period of several months, which afforded ample opportunity of trying the performances of the several forms of screws recorded in the Table given in the next page.

These experiments were made in the Bristol Channel, under circumstances of weather, as nearly as possible similar, and the distances

were very carefully measured by two of Massey's Logs, whose accuracy had been previously tested.

It will be observed, that the greatest velocity of vessel, 8.375 knots, was attained by Mr. Smith's screw of five feet 9 inches diameter, the angle of which was 19½ degrees, and the slip was 21 per cent.; that is, the ratio of speed of the vessel to that of the screw, was as .787 to 1.

Particular attention is due to experiments Nos. 5, 6, and 7.

Reasoning upon the assumption, that the effort of the entering edge of each blade must cause the water to recede, and that each succeeding portion of blade should so increase in pitch as to impinge with uniform force against the water, which was so receding, a screw of this description was made and tried before it was discovered that it was the subject of a patent by Mr. Woodcroft.

The first trial served to show, that the curvature or increase of pitch which had been given to it was too great, since the speed of the vessel was greater by two per cent. than that due to the mean pitch of the screw, whence it was evident that the entering edge was really retarding, and the terminating portion alone was doing the duty.

Number of Experiment.	Stroke of Engines per Minute.	Horse Power by Indicator.	Speed of Vessel in knots.	Speed of Screw in knots.	Ratio of Speed of Vessel to 1. of Screw.		Diameter of Screw.		Pitch.	
							Ft.	In.	Ft.	In.
1	25.41	67.10	8.375	10.646	.787	Smith's two half threads, made of wrought iron.	5	9	8	0
2	20.75	53 70	8.160	10.880	.750	Ditto. ditto.	5	9	10	0
3	26.25	63.59	7.550	8.230	.917	Ditto, made of cast iron,	7	0	6	0
4	20.50	57.13	7.420	8.520	.870	Ditto. ditto.	7	0	8	0
5	20.	57.30	8.175	8.	1.020	Woodcroft's increasing pitch, 3 blades, made of cast iron, as first made.	7	0	7	7½
6	21.50	62.60	8.10	8.10	1.	The same, with 3 inches cut off the entering edge of the blades.	7	0	7	2½
7	22.50	62.12	8.20	8.730	.940	The same, with 4 inches cut off the entering edge of the blades.	7	0	7	5
8	20.50	51.40	7.490	8.566	..	Four wrought iron arms, with blades, each 2 feet 9 inches long by 1 foot broad.	7	0	8	0

On the second trial, when a radial strip 3 inches in width had been cut off the after part of each blade, the speed of the vessel was exactly that due to the screw; whence it was also evident, that the front edge still did not assist.

On the third trial, after a second radial slip of 4 inches had been cut off the entering edge of each blade, the vessel attained a speed of 8.2 knots, and the ratio of speed of the vessel was as .94 to 1 of the screw.

The horse-power employed on this trial, was by indicator, 62.12, and the speed of the vessel 8.2 knots, against 67.1 in the before-named trial, with the original screw of the *Archimedes*, when the speed she attained was 8.375 knots.

Although on neither of the trials numbered 5, 6, and 7 with this screw, was so great a speed of vessel attained as on that first named, it is important to draw attention to the fact, that the slip was reduced to a very small quantity.

But the horse-power exerted was also much less than in the first trial, arising from some imperfections in the cutting down of the screw and other causes, which would probably have been remedied had there been time to cast a new screw of this description; but unfortunately, just at this period, the Propeller Company required the *Archimedes* for service, and the experiments ceased.

This screw was afterwards tried by Mr. Barnes in the *Napoleon*, a very beautiful French Post-Office vessel, built by M. Normand, of Havre, when the following result was obtained :—

Horse Power exerted, 95.5.

Speed of vessel, in knots, 10.15.

Speed of screw, 11.2.

Speed of vessel to 1. of screw, .895 = 10½ per cent.

In the two cuttings down, this cast-iron screw with three blades, 9 feet in diameter, which was originally very slight, had been so much reduced in substance, that it weighed only 833 lbs. Mr. Barnes, therefore, could not venture to permit the engines to exert their full power, otherwise it is probable that a higher speed would have been attained.

The commencing angle is 17°, and the terminating one 19½°; the increase of pitch is therefore $\frac{1}{12}$th, or 8½ per cent.

The screw of the *Great Britain*, which is of wrought-iron, consists of six arms, formed by placing and riveting together four distinct forgings, or centre pieces, with arms welded to them, each of which is 6 inches thick.

Upon the extremities of these are riveted palms of plate iron, which are 4 feet 4½ inches long on their circumferential edge, by 2 feet 9 inches in height, and ⅜ inch thick.

The diameter is 15 feet 6 inches, and the pitch or helix of one revolution is 25 feet, which equals an angle of 28 degrees.

Its weight is 77 cwt.

The area of the six palms, which may be considered as the effective part of the screw, is 56·25 feet; but the area, calculated as a plane perpendicular to the axis, that is as portions of a disc, is only 47·4 feet, and the portions of the arms within the blades, present a similar area of 26·88 feet.

As the rotary velocity of the outer edge of the blades is nearly 30 miles an hour, it is important, in order to diminish friction, that they should be as accurately shaped as possible, and should present no irregularities of surface. In this instance, the object was attained, by mounting the screw on a face plate and planing the surface, by means

of a tool, to which the proper motion was given; after which it was painted several times, rubbed very smooth and varnished.

On the second trial of the *Great Britain*, on the 20th January, in the Bristol Channel, in smooth water and during a calm, the engines attained the speed of 18⅔ strokes per minute, when the speed of the vessel through the water, measured by an experienced seaman, with the common log, was 12⅓ knots.

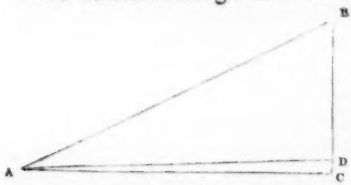
$$18{\cdot}66 \times 2{\cdot}948 \times 25 = 1375{\cdot}242 \text{ feet, velocity of the screw}$$
$$12\tfrac{1}{3} \text{ knots} \times 101{\cdot}2 = 1247{\cdot}796$$

$$127{\cdot}446 \text{ slip,—}$$

thus the speed of the vessel was ·907 to 1· of the screw.

The area of the midship section of the ship, at the time of this experiment, was 480 feet.

The annexed diagram is intended to illustrate this effect thus:—



The angle subtended by A, B, C, is an entire revolution of a screw 15 feet 6 inches diameter and 25 feet pitch, of which B, D is the forward effort communicated to the vessel, and C, D is the slip, or yielding of the water. Consequently, although the apparent angle of the screw is represented by A, B, C, the real angle is only A, C, D, since A, B, D represents the velocity of the vessel.

To be Continued.

The case of the Yarmouth Suspension Bridge over the river Yare.

An accident to this bridge, involving an extensive loss of life, occurred on the 2nd May last, arising from the excessive load upon one side of the bridge, of a great concourse of human beings assembled to witness the exploits of five geese, consisting of a clown and four geese proper. The government having appointed Mr. Walker, C. E., to examine into the causes of the catastrophe, he drew up an elaborate report on the subject, of which we give the following abstract:—

"The bridge belonged to the late Mr. Cory, father of the present owners, and was constructed from a design of Mr. Scoles', an architect in London. At first it was only a substitute for a ferry over the river Yare to the marshes. Mr. Scholes states, that he made designs for a bridge of sufficient width for a carriage and two footways. It appears that the work was offered for competition, and that Mr. Goddard (who is since dead) was the contractor for the bridge work, according to specifications prepared by Mr. Green, a surveyor at Yarmouth. These specifications describe that the iron shall be of the best charcoal iron; but make no mention as to the quality of the iron being tested. From a drawing which is now in Mr. Scoles' possession, there appears no reason to doubt that the main or suspending chains, and other parts of the bridge, are of the size which were intended.

There were altogether four suspending bars, two on each side to form a chain. These bars were connected together by bolts passing through opening or eyes at each end of them. These bars were 2½ inches wide by seven-eighths thick; from them rods of 1 inch square were suspended to carry the roadway, which was 14 feet 9 inches in width, and divided, by an iron kerb or carriage-way, from a footpath on each side, 4 feet in width. The length between the centre of the towers is 92 feet; the deflection of the chains was 7 feet 4 inches. An Act of Parliament, constituting the bridge a turnpike road was passed in May, 1830, and the road was opened in 1832. In 1842, the Yarmouth and Norwick Railway Act was passed, which contains a clause by which this bridge was constituted the only communication between the Railway station and the terminus, Mr. Cory agreeing to receive the tolls, stipulating to widen it, and afterwards to suspend it. It appears that on this occasion Mr. Scoles was again consulted, respecting the widening of the carriage-way to a width sufficient for two carriages to pass abreast—the footway being formed on each side by planks, separated by iron straps attached to the framing of the bridge. This footway was therefore outside the suspending chains. That was in 1844.

The foundations appear to have been piled well, and to have stood well. Mr. Scoles showed Mr. Walker a drawing of the piling, and, if the work had been executed according to that, Mr. W. had very little doubt of the soundness of the foundation. It is stated that the crowd collected on the 2d of May, was confined to the south side; that the crowd was composed chiefly of children in the front rank, with adults behind, to see some exhibition which was to be seen on the water. They were supposed to be four or five feet deep, and it appears that they had collected on the bridge to the number of from 300 to 500. One of the witnesses before the inquest stated that he heard a crack overhead, which induced him to look up, when he saw that one of the bars or rods of the suspending-chain was broken—that two points where the fracture had taken place were entirely separated, and that in about five minutes aftewards came the fatal catastrophe. This cracking was no doubt occasioned by the snapping in pieces of the bar which first gave way. There was now only one bar left to support the whole weight, and this bar consequently gave way in five minutes after the one on the other side; the platform, being then entirely unsupported, fell into the river. In forming these bars, the two ends had been forged separately, and then welded to a third piece, a straight bar, by scarphed or diagonal joints. It was at the weldings that the bars gave way. On examining the fracture of the bar which first broke, the weldings were found to be imperfect, insomuch as evidently not more than one-third of the surfaces were united. It was found on comparison that the second bar had stretched one inch longer than the other: this must have happened during the five minutes when it had singly to bear the strain. The qualities of the pieces of iron being tested, the middle or straight parts were found greatly superior to the ends. A piece of one of the ends was very open and coarse grained, and broke off like a piece of cast-iron when a hammer was

applied to the *middle* of the bar, another point altogether. Had the bar been perfectly tested, the defect could not have escaped detection. Another bar was tested as to fibre; it broke in pieces like a carrot. As to the strength of the bridge compared with the load, taking the load at the time of the accident to be all on the south chain, it is found by calculation that the two rods of 2½" by ⅞" are capable of sustaining a temporary load of 56 tons, without injury. Taking 400 individuals at 7 stones weight each, with the weight of the bridge, at 400 tons, the strength of the bars would exceed the load. The excess, however, was not sufficient, as at all times large allowances ought to be made for imperfections. The bridge appears to have been by no means too strong before the additions were made; and after this was done, the effect was most injurious, as the weight was placed outside the suspending chain. "In reference to the sufficiency of the bridge," he says, "to carry the greatest load which could be placed upon it, I find that its strength is somewhere a little above the weight which it would carry, but so small as not to be practically sufficient, even without any allowance for imperfections. Even before the additions were made, it appears not to have been sufficiently strong to insure perfect security, supposing a mass of people to have been packed upon it in the way in which I have described. It appears that on other occasions a very great number of persons had been upon the bridge, and that it had borne them without falling. When a bridge has been frequently loaded, to the utmost which it will bear, it becomes weaker and weaker each time, and the bridge may ultimately give way, although at first it was sufficiently strong to resist the weight put upon it." On the whole, therefore, witness had come to the following general conclusions:—

"1. That the immediate cause of the accident was a defect in the joining or welding of the bar which first gave way.

"2. That the quality of the iron and the workmanship, as far as I have been able to examine them, is defective; and I believe that the accident would not have happened had the work been properly examined at the time of construction.

"3. That the widening appears to have been made without sufficient reference to the original strength of the bridge, and the weight which it had to support, and therefore that it acted as an aggravation of the evil.

"4. That in the original construction of the bridge, the casualty of a great load all on one side does not appear to have been contemplated; if it had been, I think that the links on that side would have consisted of more than two bars, any one of which was unequal to the load which the bridge was likely to carry."

Mr. Walker added, that the weight of the bridge, including the suspending chains, before the additional width was added, was 17 tons, 14 cwt. 3 qrs. 25 lbs.: with the additional width, and the railing added, its weight was 20 tons 8 cwt. 9 lbs., making an addition of 2 tons 13 cwt. Glasgow Prac. Mech. & Eng. Mag.

New Railway Bills.

It appears, from a table published in Herapath's Railway Magazine of August 23rd, 1845, that bills were passed during the late session of Parliament, authorizing the construction of 113 new lines of railway. These new roads are found in almost all parts of England, Scotland, Ireland, and North and South Wales.

The most important line appears to be the "South Wales," of which the length is 182 miles, and the authorized capital in shares £2,800,000, and in loan £933,333.

The next in importance is the "Caledonian," 135¾ miles long, with a capital of £2,100,000 in shares, and £700,000 authorized loan.

The 113 bills embrace new railway lines, of which the aggregate length is 2,944⅝ miles, the aggregate capital in shares, £42,818,330, and authorized loan £14,541,791—making the authorized expenditure £57,360,121. C. E.

We make the following extracts from the last reports of the two greatest British railways—the London and Birmingham and the Great Western. Com. Pub.

London and Birmingham Railway.

The capital investment of this Great work now amounts to the enormous sum of £7,256,718 8*s.* 10*d.*, or about $34,832,000.

The cost of Locomotive engines to 30th June, 1845, was	£184,098	7*s.*	7*d.*
Carriages and Wagons,	£290,394	17*s.*	8*d.*
Total cost of Working Stock,	£474,493	5*s.*	3*d.*
The Company have charged to *depreciation* of Stock from the beginning	£199,031		

The following is the Statement of Revenue account, &c.

Dr.	£.	*s.*	*d.*
Maintenance of way and stations—Repairs of the permanent way, tunnels, bridges, drains, &c., 20,694*l.* 4*s.* 11*d.*; engineers' salaries, overlookers, timekeepers' wages, and office charges, 1,530*l.* 18*s.* 2*d.*; repairs of the Aylesbury Railway, 784*l.*, 2*s.*; repairs of station buildings, 1,133*l.* 10*s.* 4*d.*	24,142	15	5
Locomotive power—Wages of engine-drivers and firemen, 5,994*l.* 15*s.* 3*d.*; coke, 18,459*l.* 8*s.* 7*d.*; oil, hose-pipes, and fire-tools, pumping engines and water, 2,263*l.* 2*s.*; laborers and cleaners, waste and oil, 2,413*l.* 16*s.* 9*d.*; repairs of engines and tenders, 8,339*l.* 16*s.* 7*d.*; coals and fire-wood, expenses of stationary engine at Wolverton, repairs of buildings, gas, and incidental charges, 1,895*l.* 11*s.* 10*d.*; Superintendent, clerks, and foremen's salaries, and office charges, 2,196*l.*, 11*s.* 4*d.*; cost of locomotive			

	£	s.	d.
power for the Aylesbury Railway, 1,598*l.* 11*s.* 7d.	43,161	13	11
Police charges, viz.:—Wages and petty disbursements. 5,248*l.* 9*s.* 11*d.*; clothing, 533*l.* 10*s.* 6*d.*; gratuities to switchmen, 436*l.*; oil, lamps, flags, &c., 449*l.* 2*s.* 5*d.*,	6,667	2	10
Coach traffic charges—salaries of booking clerks and petty disbursements, 3,460*l.* 12*s.* 3*d.*; wages and gratuities to guards, ticket-collectors, and porters, 8,416*l.* 1*s.* 3*d.*; clothing for the same, 452*l.* 6*s.* 6*d.*; gas at stations, 1,161*l.* 11*s.* 11*d.*; oil, coach grease, cotton waste, fuel, water, and repairs, 2,546*l.* 8*s.* 2*d.*; stationery and tickets, 1,059*l.* 14*s.* 9*d.*; sundries, including horse-hire, 166*l.* 18*s.* 2*d.*; loss on light gold, 253*l.* 9*s.* 3*d.*,	17,517	2	3
Coach repairs, 6,039 1*s.* 3*d.*; mileage of carriages employed in through traffic, 44*l.* 1*s.* 9*d.*	6,083	3	0
Merchandize traffic charges, viz.:—Salaries wages horses, gas, and sundries, 2,585*l.* 15*s.* 5*d.*; wagon repairs, 1,567*l.* 11*s.*; less mileage of wagons employed in through traffic, 228*l.* 13*s.* 9*d.*; 1,338*l.* 17*s.* 3*d.*,	3,924	12	8
Compensation for damage and losses	463	19	7
Stores department charges,	514	8	4
General charges, viz.:—Advertising, 307*l.* 12*s.* 11*d.* Direction, 850*l.* Office charges, viz:—Secretary's, accountant's, and transfer departments, 2,371 11*s.* 8*d.* Superintendent's departments, 601*l.* 6*s.* 6*d.* Audit department, 731*l.* 0*s.* 3*d.* Clearing house, 225*l.* Sundries, viz:—Traveling expenses of Directors and superintendents, 413*l.* 5*s.* 3*d.* Dividend and interest receipt stamps, 215*l.* 13*s.* 3*d.* Wolverton schools, and all other charges not classed, 414*l.* 18*s.* 5*d.*	6,133	8	3
	108,608	6	3
Parish rates and taxes,	12,612	18	9
Duty on Passenger traffic,	13,029	12	7
Reserve, for depreciation of locomotive and carriage stock, carried to Capital Account (B 2,) 14,498*l.* Do. for the depreciation of works, carried to Capital account (B 1,) 1,000*l.*	15,498	0	0
	149,748,	17	7

Cr. Traffic, viz:—	£	s.	d.
Passengers, 293,907*l.* 7*s.* 6*d.*; mails, 7,445*l.* 13*s.* 10*d.*; horses, carriages, and dogs, 13,972*l.* 0*s.* 9*d.*; par-			

	£	s.	d.
cels, (less paid out to agents for delivery) 25,826*l.* 2*s.*	241,151	4	1
Merchandize, 98,859*l.* 0*s.* 2*d.*; cattle, 7,180*l.* 13*s.*,	106,039	13	2
	447,190	17	3
Interest on loans, balances, and calls in arrear,	3,296	13	4
Rent of lands and buildings, 3,633*l.* 10*s.* 5*d.*; less repairs and charges, 1,239*l.* 12*s.* 11*d.*,	2,393	17	6
	£452,881	8	1

Report.

The operations of the last half-year exhibited a great increase of traffic both in passengers and goods, and a considerable excess of receipts over the corresponding half-year of 1844, notwithstanding the large reductions which have since been made in the Company's fares and rates, amounting on an average of the passengers' fares of all classes, from 2·609*d.* per mile in 1844, to 1·818*d.* in 1845; and on the average rates of goods of all classes per ton, from 2·816*d.* per mile in 1844, to 2·636*d.* in 1835.

The total mileage of passengers is 38,758,260 in 1845, against 24,664,979 in 1844, being an increase of 57·143 per cent.

The total mileage of goods is 9,350,718 tons, against 6,929,875—being an increase of 34·933 per cent.

The receipt for the gross ordinary traffic for 1845, is	£447,190
1844, is	405,768
Increase,	41,422
The charge on the traffic for 1845, is	108,382
1844, is	92,823
Increase to charge,	£15,560

The chief increase of charge is in the locomotive department, arising from the additional work required from the engines, which amounted

For the half-year of June, 1845, to	£43,161
Against the charge for 1844, of	32,603
Increase,	£10,558

But the Directors having made provision, as stated in their last report, for a supply of engines of greater power than those hitherto employed, and better calculated for the extended carrying business of the Company, although disappointed in their delivery as early as was expected, they contemplate a large prospective reduction of expense under this head in the course of next year, when these engines will have been brought into work.

The Directors trust also, that the charge for maintenance of way will be progressively reduced under the operation of new contracts, which, owing to the improved state of the works, they have been enabled to make at lower prices than those previously subsisting.

Comparative Mileage of Passenger Traffic for the half-years ended 30th June, 1843, 1844, and 1845.

	Number of Passengers.	Miles traveled.	Average Number of Passengers per day.	Average number of Miles traveled by each Passenger.	Equal to the undermentioned No. of Passengers traveling the whole way, (112 miles) per day.
Half-year ended 30th June, 1843,.....	360784	23395261	1982	64¾	1147
Half year ended 30th June, 1844,.....	371331	24664979	2040	66½	1210
Half-year ended 30th June, 1845,.....	615904	38758260	3384	62¾	1901
	The same for the half-years ended 31st December, 1842, 1843, and 1844.				
Half-year ended 31st December, 1842,.....	407840	26563216	2216	65¼	1289
Half year ended 31st December, 1843,.....	419943	26983482	2282	64½	1308
Half-year ended 31st December, 1844,.....	480367	31122885	2611	64¾	1510

Comparative Statement of half-yearly Traffic Receipts and Disbursements, from July 1, 1842, to June 30, 1845.

RECEIPTS.	Half-year ending 31st Dec., 1842.			Half-year ending 30th June, 1843.			Half-year ending 31st Dec., 1843.			Half-year ending 30th June, 1844.			Half-year ending 31st Dec., 1844.			Half-year ending 30th June, 1845.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£.	s.	d.
Passengers,.....	282595	12	9	254180	7	11	287333	0	4	268137	4	7	294569	13	4	293907	7	6
Mails,.....	7314	19	2	7125	13	10	7314	19	9	7352	4	3	7564	12	8	7445	13	10
Horses, carriages, and dogs,.....	18550	16	4	15966	2	6	17122	7	0	15931	3	11	15385	12	0	13972	0	9
Parcels,.....	25913	8	4	23125	4	1	25711	17	1	23638	16	8	27417	17	0	25826	2	0
Merchandize,.....	79081	13	11	77479	18	11	81276	10	2	84022	11	3	92241	0	7	98859	0	2
Cattle,.....	7502	7	6	7256	19	6	13598	13	8	6686	14	6	13300	0	10	7180	13	0
	420958	18	0	385194	6	9	432357	7	5	405768	15	2	450478	16	6	447190	17	3
EXPENDITURE.																		
Maintenance of way and stations,.....	22711	7	7	22451	4	2	22049	18	8	22540	14	3	22767	7	11	24142	15	5
Locomotive power,.....	38640	15	1	32853	12	5	34261	4	0	32603	9	7	36145	10	9	43161	13	11
Coaching and merchandize charges,.....	34582	13	7	27994	10	1	33742	9	9	31748	2	10	30717	12	10	34650	0	4
General charges,.....	6966	0	6	6083	9	8	6632	9	11	5930	15	3	6782	13	5	6647	16	7
	102907	16	9	89382	16	4	96686	2	4	92823	1	11	96413	10	11	108608	6	3

The Great Western Railway.

The capital investment of this Company for the main line to June 30th, 1845, was £6,746,533.

For the main road and branches, £6,717,043, or about $37,041,000.

The following is the Revenue account, from the 1st January to the 30th June, 1845.

Expenditure.

	£	*s.*	*d.*
Maintenance of way, stations and works,	26,489	17	8
Locomotive account, viz :—coal, coke, repairs, wages to drivers, firemen, &c., oil, tallow, and all other incidental expenses,	47,990	8	4
Carrying account, viz :—Wages to guards and conductors, police, messengers and porters, clothing, repairs of carriages, oil, tallow, &c.,	34,765	9	6
General charges, viz :—Superintendents' and clerks' salaries, advertising, printing, stationery, and sundries, including traveling expenses,	15,014	14	1
Disbursements for repairs and alterations of stations, &c., and for insurance,	337	8	9
Compensation returns and allowances,	569	14	6
Government duty on gross receipts from passengers,	13,274	0	10
Rates and taxes,	12,634	16	0
General offices, for direction, salaries, and all office expenses,	2,290	13	8
	£153,367	3	4
Amount chargeable to revenue for the renewal and depreciation of plant during this half-year,	5,000	0	0
Balance for the half-year, ending 30th June, 1845,	274,929	12	10
	£433,296	16	2

Receipts.

	£	*s.*	*d.*
Traffic in Passengers,	285,311	0	2
Carriages, horses, and dogs,	11,055	3	0
Expresses,	193	16	0
Mails, including further payment for services to 22nd June, 1844, under award	32,314	13	5
Merchandize, 87,504*l.* 14*s.* 11*d.* Less for compensation allowed for loss by fire, 2,843*l.* 2*s.* 7*d.*,	84,661	12	4
Warehouse rent,	42	14	7
Parcels,	15,468	15	9
Rent from the Bristol and Gloucester Railway Company, for use of the Bristol station, and of the line between Standish and Gloucester,	3,278	1	8
Rents, &c.,	679	14	3
Registration fees,	291	5	0
	£433,296	16	2

Comparative Mileage of Passenger Traffic for the half-years ending 31st December, 1842, 1843, and 1844.

	Number of passengers.	Miles traveled.	Average Number of Passengers per day.	Average Number of miles traveled by each passenger.	Equal to the undermentioned number of passengers traveling the whole way, (112 miles) per day.
Half-year ending 31st December, 1842,.....	869444	28497610½	4725	32¾	950
Half-year ending 31st December, 1843,.....	904022½	29584641½	4913	32¾	846
Half-year ending 31st December, 1844,.....	963337	34894796½	5235	36	854
The same for the half-years ending 30th June, 1843, 1844, and 1845.					
Half-year ending 30th June, 1843,.....	725127½	24358082½	4006¼	33½	823
Half-year ending 30th June, 1844,.....	827935	28077082	4549	33⅞	777
Half year ending 30th June, 1845,.....	1029751	35967713	5689	34 9.10	871

Comparative Statement of half-yearly Receipts from 1st July, 1842, to 30th June, 1845.

	Half-year ending 31st Dec., 1842.			Half-year ending 30th June, 1843.			Half-year ending 31st Dec., 1843.			Half-year ending 30th June, 1844.			Half-year ending 31st Dec., 1844.			Half-year ending 30th June, 1845.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Passengers,..... } Mails,..... } Horses, carriages, and dogs,..... .... }	283947	9	9	254603	2	4	297081	13	7	283906	0	9	339550	19	11	332152	14	3
Parcels,.....	16315	16	11	13871	7	9	15877	12	8	14460	14	11	16082	5	9	15468	15	9
Merchandize,..... } Cattle,... .... }	58400	14	1	61528	18	0	64359	8	5	70883	17	7	83466	17	8	84704	6	11
	358664	0	9	330003	8	1	377318	14	8	369250	13	3	439100	3	4	432325	16	11
Ratio of expenditure computed at per £100 of the above receipts,	36·011			37·702			34·404			34·457			32·630			35·475		

Railways in Portugal.

Lisbon, Saturday, July 12.

A council of Ministers was held the day before yesterday for the purpose of taking into consideration and announcing the decision of the Government upon the several railway projects for Portugal, which have been lately submitted. Their Majesties came up from Cintra expressly to preside at this council, and returned thither in the evening.

There were eleven different proposals before the Government, all from foreign Companies, with the exception of one Portuguese. One was French, and the remainder English. These were all independent of the contract already concluded with the Company dos Obras Publicos for the formation of a railway from Lisbon to Badajoz. Of these, the following have been definitely rejected:—The English Company, by Mr. Hyslop, for a railway north from Lisbon by Coimbra to Oporto, and thence to Corunna. The French Company, by Monsieur Jucan, for a railway, likewise north, from Lisbon, by Coimbra, to Oporto, and thence by Braganza into Spain. Two proposals by Mr. Benjamin Oliveira, of London, the chief of which was for a railway from the Caclihas, on the south side of the Tagus, immediately opposite to Lisbon, by Evora and Bega, to Seville, in Spain. Two proposals by an English Company for the formation of railways in the Alto-Douro, one on the north and the other on the south side of the river, embracing the principal towns on either side, and meeting at Torre de Moncorvo, from whence a single line was to pass into Salamanca, in Spain. The two remaining projects which were rejected were of minor importance, and were to proceed by routes which present no reasonable prospect of traffic to repay the outlay.

The following three projects were entertained, and though the Government has not yet finally bound itself to accept them, they may perhaps be proceeded with:—two proposals by an English Company, by Mr. Clegg, one for the railway from Lisbon to a point between Campo Grande and Benifica (the terminus to be a little northward of the Passeio Publico, or public gardens,) and thence by the coast as far as Cascaes, taking in the small intermediate sea-bathing towns, and to Cintra. The other of Mr. Clegg's proposals is to continue the preceding railway northward by Coimbra to Oporto, and thence by Braganza to Spain. The third and last proposal which has been entertained is one by an English Company, by General Bacon, for the formation of a railway from Lisbon through Alemtejo by Evora to Elvas and Badajoz. An inconvenience connected with the latter project is, that it interferes directly with the contract already concluded between the Government and the Company dos Obras Publicos, for the construction of a railway between the same termini of Lisbon and Badajoz, by a line very little different. The Government is not disposed to meet this difficulty by releasing the Company dos Obros Publicos from this part of its engagement, and holding it responsible for the execution of the other works which it has undertaken—the

Ratio of expenditure computed at per £100 of the above receipts, 36·011 | 37·762 | 34·404 | 34·457 | 32·630 | 35·475

construction of roads and canals throughout the kingdom, the circumvallation of Lisbon for fiscal purposes, &c. The Company has deposited 600 cantos (about 150,000*l.*) of forfeit money, and of course as there are two parties to every contract, the company may not choose to forego the railway portion of its agreement. The several parties are now in negotiation, and the result will be speedily known. Senhor Silva Cabral is of opinion that the terms offered by the English company, as compared with those offered by the Portuguese company, are so advantageous to the Government, that the latter has the right of option. General Bacon, in fact, makes the most extensive offers, and appears rather to be on the side of offering too much.

Herapath's Jour. & Railway Mag.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The Wire Suspension Aqueduct over the Allegheny River, at Pittsburgh.

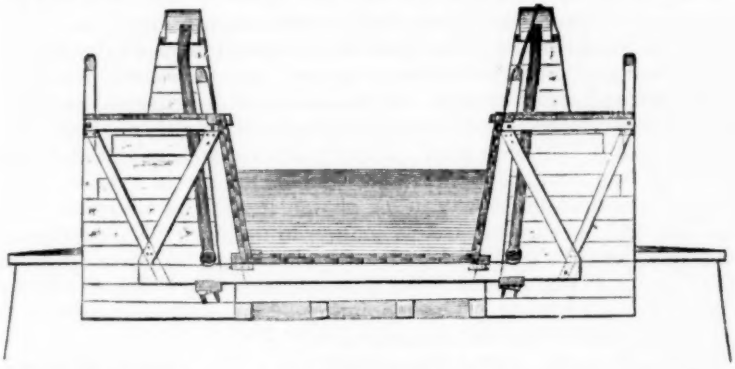
This work, recently constructed under the superintendence of John A. Roebling, the designer and contractor, has supplied the place of the old wooden structure which originally was built by the State of Pennsylvania at the western termination of the Pennsylvania Canal.

The Council of the city of Pittsburgh, by whom, in consequence of an arrangement with the State, the tolls on this aqueduct are of late received, and who are bound to keep the work in repair, decided on re-building, and after considering various plans, adopted that of Mr. Roebling, and entered into contract with him to re-construct the communication, for the gross sum of $62,000, including the removal of the old ponderous structure and the repair of the pier and abutments; a very small sum indeed for a work of such magnitude. As this work is the first of the kind ever attempted, its construction speaks well for the enterprize of the city of Pittsburgh.

The removal of the old work was commenced in September, 1844, and boats were passed through the new aqueduct in May, 1845.

This work consists of 7 spans, of 160 feet each, from centre to centre of pier. The trunk is of wood, and 1140 feet long, 14 feet wide at bottom, 16½ feet on top, the sides 8½ feet deep. These, as well as the bottom, are composed of a *double* course of 2½ inch white pine plank, laid diagonally, the two courses crossing each other at right angles, so as to form a solid lattice-work of great strength and stiffness, sufficient to bear its own weight and to resist the effects of the most violent storms. The bottom of the trunk rests upon transverse beams, arranged in pairs, four feet apart; between these, the posts which support the sides of the trunk are let in with dove-tailed tenons, secured by bolts. The outside posts, which support the sidewalk and tow-path, incline outwards, and are connected with the beams in a similar manner. Each trunk-post is held by two braces, 2½ × 10 inch, and connected with the outside posts by a double joist of 2½ × 10. The trunk-posts are 7 inches square on top, and 7 × 14 at the heel; the transverse beams are 27 feet long and 16 × 6 inches; the

space between two adjoining is 4 inches. It will be observed, that all parts of the framing are double with the exception of the posts, so as to admit the suspension rods. Each pair of beams is supported on each side of the trunk by a double suspension rod of 1⅛th inch round iron, bent in the shape of a stirrup, and mounted on a small cast-iron saddle, which rests on the cable. These saddles are connected, on top of the cables, by links, which diminish in size from the pier towards the centre. The sides of the trunk set solid against the bodies of masonry, which are erected on each pier and abutment as bases for the pyramids which support the cables. These pyramids, which are constructed of 3 blocks of a durable, coarse, hard-grained sand-stone, rise 5 feet above the level of the side-walk and tow-path, and measure 3 × 5 feet on top, and 4 × 6½ feet at base. The side-walk and tow-path being 7 feet wide, leave 3 feet space for the passage of the pyramids. The ample width of the tow and foot-path is therefore contracted on every pier, but this arrangement proves no inconvenience, and was necessary for the suspension of the cables next to the trunk.



The caps which cover the saddles and cables on the pyramids rise 3 feet above the inside or trunk railing, and would obstruct the free passage of the tow-line; but this is obviated by an iron rod which passes over the top of the cap and forms a gradual slope down to the railing on each side of the pyramid.

The wire cables, which are the main support of the structure, are suspended next to the trunk, one on each side; each of these two cables is exactly 7 inches in diameter, perfectly solid and compact, and constructed in one piece from shore to shore, 1175 feet long; it is composed of 1900 wires of ⅛th inch thickness, which are laid parallel to each other. Great care has been taken to insure an equal tension of the wires. Oxidation is guarded against by a varnish applied to each wire separately, their preservation, however, is insured for certain by a close, compact, and continuous wrapping, made of annealed wire and laid on by machinery in the most perfect manner. A continuous wrapping is an important improvement, which, in this case, has been for the first time successfully applied.

A well-constructed and well-wrapped cable presents the appear-

ance of a solid cylinder, which in strength greatly surpasses a chain, made of bars of the same aggregate section or weight. It is not only the great relative strength of wire which renders it superior to bar iron, but its greater elasticity, which enables it to support strong and repeated vibrations, add still more to its value as a material for bridge building.

The extremities of the cables do not extend *below* ground, but connect with anchor chains, which, in a curved line, pass through large masses of masonry, the last links occupying a vertical position. The bars composing these chains average $1\frac{1}{2} \times 4$ inch, and are from 4 to 12 feet long; they are manufactured of boiler scrap and forged in one piece without a weld. The extreme links are anchored to heavy cast-iron plates of 6 feet square, which are held down by the foundations, upon which the weight of 700 perches of masonry rests. The stability of this part of the structure is fully insured, as the resistance of the anchorage is twice as great as the greatest strain to which the chains can ever be subjected.

The plan of anchorage adopted on the aqueduct varies materially from those methods usually applied to suspension bridges, where an open channel is formed under ground for the passage of the chains. On the aqueduct, the chains below ground are imbedded and completely surrounded by cement. In the construction of the masonry, this material and common lime mortar have been abundantly applied. The bars are painted with red lead. Their preservation is rendered certain by the known quality of calcareous cements to prevent oxidation. If moisture should find its way to the chains, it will be saturated with lime and add another calcareous coating to the iron. This portion of the work has been executed with scrupulous care, so as to render it unnecessary on the part of those who exercise a surveillance over the structure to examine it. The repainting of the cables every 2 or 3 years, will insure their duration for a long period.

Where the cables rest on the saddles, their size is increased at two points by introducing short wires and thus forming swells, which fit into corresponding recesses of the casting. Between these swells, the cable is forcibly pressed down by three sets of strong iron wedges, driven through openings which are cast in the side of the saddle.

When the merits of the suspension bar were discussed previous to the commencement of the structure, doubts were raised as to the stability of the pyramids and the masonry below, when unequal forces should happen to disturb the equilibrium of adjoining spans. It was then proved by a statistical demonstration, that any of the arches with the water in the trunk, could support an extra weight of 120 tons, without disturbance to any part of the work. In this examination, no allowance at all was made for the great resistance of the wood-work and the stiffness of the trunk itself. During the raising of the frame-work, the several arches were repeatedly subjected to very considerable unequal forces, which never disturbed the balance, and proved the correctness of previous calculations.

The stiffness and rigidity of the structure is so great, that no doubt is entertained that each of the several arches would sustain *itself* in

case the wood-work of the next one adjoining should be consumed by fire. The wood-work in any of the arches separately may be removed and substituted by new material, without affecting the equilibrium of the next one.

The original idea upon which the plan has been perfected, was to form a *wooden trunk*, strong enough to support its own weight, and stiff enough for an aqueduct or bridge, and to combine this structure with wire cables of a sufficient strength to bear safely the great weight of water.

The plan of this work, therefore, is a combination which presents very superior advantages, viz., *great strength, stiffness, safety, durability*, and *economy*.

This system, for the first time successfully carried out on the Pittsburgh aqueduct, may hereafter be applied, with the happiest results, to railroad bridges, which have to resist the powerful weight and great vibrations, which result from the passage of heavy locomotives and trains of cars.

REMARK.—The quantities in the following table are calculated for a depth of water of 4 feet, which has been in the aqueduct ever since the opening. The depth contemplated was 3½ feet; a greater depth is at present required on account of the raising of the bottom of the canal by bars and sediment, which have to be removed before the level can be lowered.

Table of Quantities on Aqueduct.

Length of Aqueduct without extensions,	1,140 feet.
Length of cables,	1,175 "
Length of cables and chains,	1,283 "
Diameter of cables,	7 inches.
Aggregate weight of both cables,	110 tons.
Section of 4 feet of water in trunk,	59 sup. feet.
Total weight of water in aqueduct,	2,100 tons.
" " one span,	295 "
Weight of one span, including all,	420 "
Aggregate number of wires in both cables,	3,800
Aggregate solid section of both cables,	53 sup.inch's
" " anchor chains,	72 "
Deflection of cables,	14 feet 6 in.
Elevation of pyramids above piers,	16 feet 6 "
Weight of water in 1 span *between* piers,	275 tons.
Tension of cables resulting from this weight,	392 "
Tension of one single wire,	206 lbs.
Average ultimate strength of one wire,	1,100 "
Ultimate strength of cables,	2,090 tons.
Tension resulting from weight of water upon 1 solid square inch of wire cable,	14,800 lbs.
Tension resulting from weight of water upon 1 square inch of anchor chains,	11,000 "
Pressure resulting from weight of water upon 1 pyramid,	137½ tons.
" " " " " " 1 superficial foot,	18,400 lbs.

AMERICAN PATENTS.

List of American Patents which issued in the month of February, 1845, *with Remarks and Exemplifications. By* CHARLES M. KELLER, *late Examiner of Patents in the U. S. Patent Office.*

1. For improvements in the *Cultivator;* R. H. Springsteed, Wooster, Wayne county, Ohio, February 12.

In this cultivator, which is adapted to the planting of seed, the frame is made to expand and contract, like the expansion harrow. The ploughs are arranged diagonally across the frame, and are connected with it by means of journals, to admit of adjustment as the frame is expanded or contracted. The seeds are dropped in two rows, one on each side, by means of cams on the shaft of a running wheel that supports the back of the machine, which cams operate two slides for dropping the seeds.

Claim.—"I do not claim a cultivator with the side beams of the frame moveable, nor do I claim the spreading contracting seed planters, or the extension of shafts as described in my machine, as it has been before used for various purposes; but what I do claim as my invention and desire to secure by letters patent, is the arrangement of the ploughs as herein described, by means of the curved side pieces of the frame, said side pieces being made so that they can be expanded for the purposes herein set forth.

"I also claim in combination with the above, the shaft constructed so as to extend as herein described, combined with, and operating the slides in the hoppers.

"I further claim the construction of the back of the plough as herein described, so as to fasten all the parts by hooking the land slide into the cutter, as described."

The shaft that carries the cams for operating the slides for dropping the seeds are made with sliding coupling boxes.

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2. For an improvement in the *method of Evaporating Brine in the Manufacture of Salt;* James S. O. Brooks, Kanawha county, Virginia, February 12.

The object of this improvement is to apply heat to the brine at the top, as it is believed that this improves the crystalization.

Claim.—"I do not claim applying heat to the surface of the brine for the purpose of crystalizing the salt, as that has before been done, but I confine my claim to the mode herein described of applying the heat to the surface of the brine as that surface rises or falls, by means of the revolving or floating pipe, constructed and operating substantially as herein described. Its advantages are two-fold: 1st preserves a low degree of heat in all parts of the cistern; 2nd is a convenient mode of preventing the currents in the lower strata of brine."

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3. For an *improvement in Door Hinges;* Robert B. Varden, Baltimore, Maryland, February 12.

One half of the hinge is provided with several wings, a plate, or a segment with holes, to receive the end of a sliding pin for the purpose of holding the shutter, &c. in any position desired.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the arrangement of the bolt or pin in combination with the wings and perforated segments and plate on one half of the hinge, or on the shutter, by which means the shutter or blind can be fastened and held in any position corresponding with the holes or wings, as described."

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4. For an improvement in *Carding Machines;* Hugh Whitman, Pittsburgh, Pennsylvania, February 12.

The patentee says:—"My invention consists in dispensing entirely with the main cylinder of the common carding machine, and disposing the lickerin and the strippers and workers around the lower part of the periphery of the doffer so as to act doubly, both receiving and delivering the material to be carded directly from and to the doffer, without the aid of the main cylinder."

Claim.—"What I claim as my invention is the dispensing with the main cylinder of the common carding machine, by so disposing of the lickerin and workers and strippers around the lower part of the circumference of the doffer and giving them such motion as to deliver to and receive from the doffer itself, without the aid of the main cylinder."

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5. For an improvement in the method of *making Wrought-iron Cannon;* Daniel Treadwell, Cambridge, Massachusetts, Feb. 12.

The following claim fully explains the nature of this invention.

Claim.—"I have invented a new and improved kind of cannon, which is formed of a series of rings, or short hollow cylinders, joined together by their ends, in sufficient numbers to form the length required for the cannon."

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6. For an improvement in the *Wagon Lock;* Daniel D. Gibson and Walker Cobb, Damascoville, Columbiana county, Ohio, February 12.

The body of this carriage slides on the frame, and the brake is jointed to this frame with a lever extending up to the body, so that in going down hill the sliding of the body on the frame forces the brakes against the back wheels; and for the purpose of relieving the brake when the carriage reaches a level, the brake is connected by a chain with the swingle trees, so that the pull of the horses removes it from the wheels.

Claim.—"What we claim as our invention and desire to secure by letters patent, is the mode of operating the brake by means of the body sliding on the frame and connected with the levers of the brake, in combination with the mode of removing the brake from the wheels, by connecting it with the swingle tree, substantially as herein described."

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7. For an improvement in the *Mill for cutting and grinding Corn-*

cobs and Fodder; E. A. Knowlton, Columbia, Richland county, South Carolina, February 12.

This patent is granted for making recesses in the face of the bed stone of a peculiar form, to receive the substances to be crushed, from the eye of the runner, provided with an inclined recess to facilitate the delivery into the recesses of the bed stone. The claim is to the form of the recesses in the bed stone, and also to the combination of these with the recess in the runner. As the claim refers to, and is dependent on the drawings, we are under the necessity of omitting it.

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8. For improvements in the *Machine for Crimping Boots;* Cosman White, Galway, Saratoga county, New York, February 12.

The first section of the following claim needs no explanation, and in the second section, the object of the channel plates in the jaws referred to is to receive, in grooves made therein, projections from the gripers, to steady their operation.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the construction of the two hinged gripers for holding the ends of the leather whilst straining it—that is to say, being made with openings in the lower end of the gripers, beveled on the inside, or wider on the outer than on the inner face, into which are fitted loosely hinged shutters of corresponding size and shape, between which and the griper the end of the leather is griped. A projection or cog being formed on the lower end of each griper, that runs back and forth in the horizontal grooves in the plates in the head of the jaws—the upper ends of the gripers being hinged to the horizontal connecting bar containing the female screw, into which is screwed the vertical male screw, passing through the top of the sliding frame.

"I also claim constructing the jaws with the channeled plates, in the manner and for the purpose set forth."

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9. For an improvement in the *Summer Baker for Cooking purposes;* John T. Davy, Troy, Rensselaer county, New York, February 12.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner in which I have combined the oven and fire-box, (being surrounded by an air chamber perforated through the top plate, with the holes communicating with the oven,) the oven being directly over the fire-box, and the smoke-pipe ascending through the oven, and the flame and smoke being distributed over the top of the oven, in the manner described, these features in combination constituting the economy of my summer baker, the whole arrangement and combination being substantially as herein set forth."

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10. For an improvement in *Bee Hives and the mode of managing Bees;* Elias Jones, Amsterdam, Montgomery county, New York, February 12.

The patentee says:—"My improvement consists in a certain new and useful combination and arrangement of a horizontal series of parallel perforated tubes for conducting the warm breath of the apiarian

to the vicinity of the joint between the boxes where the separation and division are required to take place, for the purpose of driving the bees to any part of the boxes required whenever it becomes necessary to colonize them, said tubes serving also to sustain the comb in the boxes and to admit air for ventilation and slides for closing them in winter, said slides also strengthening the tubes, to secure the comb attached to them. Also, in the arrangement of other tubes in the sides of the boxes, to admit the breath of the apiarian for directing the bees to the position required in the boxes, for the purpose above set forth.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the arrangement of the horizontal parallel tubes and slides, and the manner of dividing the bees by means of the breath, as set forth."

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11. For an improvement in the *Cotton Whipper;* Fones McCarthy, Demopolis, Marengo county, Alabama, February 12.

The cotton to be operated on is put on an endless belt of slats, and thus introduced to the action of rotary beaters which act on the cotton against the edges of the slats that compose the endless belt.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the revolving whipper with the endless conveyor, arranged and operated in the manner and for the purpose set forth."

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12. For improvements in the *Plough;* Seth J. Roberts, Jeffersonville, Montgomery county, Pennsylvania, February 12.

The land side or cutter is made with a recess to receive a bit called the "stubble bit," for cutting stubble.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the stubble bit with the land side casting, in the manner and for the purpose set forth."

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13. For improvements in the *Machine for cutting Files;* Solomon Whipple, Albany, New York, February 12.

The claims in this patent are numerous and wholly dependent on the drawings, which being too complex and numerous to admit of insertion, we are under the necessity of passing them over.

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14. For an improvement in the mode of *making Pantaloon Buttons;* John Hatch, Attleborough, Massachusetts, February 20.

The following claim fully expresses the nature of this improvement.

Claim.—"I do not claim the making of what is termed the pantaloon button in two pieces of metallic plate, held together by the edge of one being turned over upon that of the other, nor do I claim the combination of two plates (so applied to each other,) with a circular or other proper shaped piece of wood, or cloth, or woven material interposed between them; neither do I claim the combination of a plate of metal and a circular disk of wood together, the former being confined to the latter by its edges being lapped over and pressed down

upon those of the latter: but what I do claim, is my improvement in the modes usually adopted for forming or making the eyelet holes or thread passages of buttons composed of two circular plates of metal, the one of said pieces being confined to the other as above described; the said improvement consisting in punching holes through the plates, (so as to leave a bur projecting on one side of the plate from each hole) before they are applied and connected to each other, and (in combination with) applying the said holes of one plate to those of the other, in such manner that their burred projecting edges may be in direct contact, and the countersunk portion of each of the holes of the plate (there being the same number of holes in each plate) be opposite to that of the corresponding hole of the other plate, thereby forming eyelets or passages countersunk on *both sides* of the *button;* by which mode of constructing the above, wear of the threads which secure the button when sewed to cloth or other material, is to a very great degree obviated—the whole being substantially as above described."

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15. For an improvement in the tool called the *Shoemaker's Shoulder Iron, for setting and polishing the edge or forepart of the Soles;* James W. Newberry, Kensington, Philadelphia county, Pennsylvania, February 12.

In the instruments or tools now used for this purpose, the bevel edge, which is used to polish the edge of the sole, is permanently connected with the shoulder which determines the thickness of the sole, and therefore one instrument is required for each thickness. This patent is granted for connecting the bevel edge with the shoulder by a slide regulated by a screw, so as to adapt one instrument to any thickness of soles. The claim is limited to the combination of the bevel edge and shoulder, in the manner described, the distance between the two being regulated by a screw or other analogous device.

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16. For improvements in *Printing Presses;* J. C. Kneeland, Troy, Rensselaer county, New York, February 20.

The patentee says—"In my press as represented in the drawings accompanying the specification, I place the form vertically; but it may, if preferred, be placed horizontally, by arranging the toggle joint and the other parts concerned in giving the impression in such manner as to operate in that position, my improvement not relating to that part of the apparatus by which the platen, the frisket, the inking apparatus and their immediate appendages are operated, or in which they are arranged, these being similar to such as are well known, but consisting, principally, in a novel arrangement of the apparatus for griping the sheet which is placed on the feeding board; and for carrying it into the proper position for, and holding it whilst it is, receiving the impression."

We are under the necessity of omitting the claim, as it refers to, and is wholly dependent on, the drawings; but the foregoing extract from the specification fully indicates the nature of the improvement patented.

17. For an improvement in the *Plough;* E. Ball, Greentown, Stark county, Ohio, February 20.

The self-sharpening point of this plough is made reversible and double so that it can be turned over and end for end. It is received in a recess in the land side, and the lower end of the coulter is also received in a recess in the land side and the reversible point, and the three are secured together by means of two bolts passing through them all.

Claim.—"What I claim as my invention, and desire to secure by letters patent is, the manner in which I have combined the coulter, the landside, and the self-sharpening point, so that the three may be secured together by two bolts, giving at the same time great strength to these as herein above described."

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18. For improvements in *Cooking Stoves;* Robert Wilson, Williamsport, Lycoming county, Pennsylvania, February 20.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is

"1st. The combination of a set of flues and dampers, as above described, between two horizontal plates, for the purpose of drawing the flame and heated air around and about the boilers or kettles, as herein set forth, by which I admit the flame and heated air through the lower horizontal plate into the flues above named at one side or portion of the boiler apertures, thereby obliging the draught first to cross the bottom of the boilers or kettles and then through the apertures in the horizontal plate, thence around the boilers or kettles through the flues to the pipe.

"2nd. I claim the combination and arrangement of the cylinder (S, T,) for burning coal with the plates (C and D,) in the manner and for the purpose described."

The cylinder S, T, referred to in the claim, has a grate at bottom for coal, and apertures near the top which open into a space between two plates C and D, to conduct the draught to the chimney and cause it to circulate around the kettles.

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19. For an improvement in the *Straw Cutter;* D. M. Seckler, of Wooster, Wayne county, Ohio, February 20.

This is for a method of regulating the feed of a straw cutter, by having the hand or "click" which acts on a ratchet wheel on the arbor of the feed rollers, operated on by pins on the gate which act on the feed hand, or "click," at each upward motion of the gate.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the lever with its click and ratchet wheel in combination with the pins or studs upon the cutter gate, by which I regulate the length of the feed, and at the same time insure the operation of the pins upon the click; all of which being arranged, constructed, and operated, as herein above described."

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20. For an improved mode of *Preventing the Explosion of Steam*

Boilers; Cadwallader Evans, Pittsburgh, Pennsylvania, February 24.

The patentee says—"The nature of my invention consists in the application of the difference in the expansion of two metals or the expansion of a metal so applied as to cause a safety valve to open, to regulate the supply of water in the boilers, to give notice of the fall or scarcity of water, to regulate a damper, to extinguish the fire by letting water spout on it, and to show the relative temperature of the steam or boiler; all of which can be performed by the same machine respectively, and at the time required, or each can be applied separately.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the difference in the expansion of two metals or the expansion of a metal, as a means of preventing explosions of steam boilers, in the manner described, or any analogous means producing the same result or effect."

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21. For an improvement in the *Hot Blast Bloomery Forge Fire;* Paul A. Sabbaton, Reading, Berks county, Pennsylvania, February 24.

On each side of the fire place there is a large horizontal tube, one to receive the blast of air from the blower, and the other connected with the tuyers, and these two pipes are connected together for the passage of the air by means of bent tubes in the form of an inverted U, and placed immediately over the fire to have the flame impinge on them.

Claim.—"I do not make any claim to the applying of the hot blast thereto; nor do I make any claim to the form or combination of the pipes for heating the air, this being the same with numerous others which have been long known and used; but what I do claim as my invention and desire to secure by letters patent, is the manner in which I have combined said pipes with the bloomery forge fire, by placing them within the chimney immediately over said fire; which chimney is formed in the manner herein described and represented, so as to effect the desired object, without the use of an arch, or of any analogous structure. To this particular combination and arrangement, I limit my claim."

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22. For an improvement in the mode of *Preventing the Explosion of Steam Boilers;* Wm. M. Wright, Pittsburgh, Pennsylvania, February 24.

The following claim gives a sufficiently clear notion of these improvements.

Claim.—"1st. What I claim as my invention is the modes of liberating and reclosing the valves, in combination with the expansion tube and rod, the rod being hermetically attached to the inner end of the tube, by which arrangement a stuffing box for establishing the connexion between the inside and outside of the boiler is dispensed with as described. 2nd. What I also claim is so connecting the safety

valves with the expansion rod as to reclose the valve by the contraction of the metal after a given quantity of steam has blown off, as herein described.

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23. For a mode of *Reducing Grain by Pounding ;* Fones McCarthy, Demopolis, Marengo county, Alabama, February 24.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the bed in which the grain is ground, and through which it is discharged when ground to the degree of fineness required—that is to say, constructing the centre of the bed with a longitudinal semi-circular or other concave depression in combination with the sides, flaring outward and upward, forming the inclined planes which are perforated with apertures of the size to which the grain is to be reduced and through which the same is discharged when thus reduced; said inclined sides serving also the purpose of conductors of the grain to the bed, and as guards to prevent its escape therefrom, in combination with the pounders, as herein described."

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24. For an improvement in *Temples for Power Looms ;* Erastus B. Bigelow, Boston, Massachusetts, February 24.

In this temple the upper jaw is attached to one end, and the lever by which it is worked to the other end of a rod jointed to a long bar, which is in turn jointed to the breast beam of the loom, so that the lay shall strike the lever that opens the jaw at a considerable distance from the jaw.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is having the movable jaw at one end, and the lever by which it is operated, at the other end of the rod, and near to the joint which connects the bar to the beam, in combination with the long bar jointed to the breast beam, so as to act when there is little or no motion, by which the operation is rendered more effective and the free action unimpeded and more certain."

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25. For an improvement in the *Speeder Flyer ;* Erastus B. Bigelow, Boston, Massachusetts, February 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is extending the shaft of the presser down from the pressing arm, to the bottom of the flyer, and providing the lower end thereof with an arm, which, in combination with the spring attached to the flyer, enables the attendant to throw back the presser, which is there retained, till the spool is doffed and replaced by an empty one, as herein described."

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26. For an improvement in the machine for *Filing Saws ;* Jacob Arndt, Wheeling, Virginia, February 24.

The file is secured to a frame which slides lengthwise and vertically on a bar that swivels in the end of a jaw in which the saw is clamped,

and there is a spring that bears up the file frame against the teeth of the saw.

Claim.—"What I claim as my invention, is the combination of the grooved block, which embraces the saw with the bar joined thereto in the middle, and the file frame which slides vertically and horizontally on the bar; the said file frame being provided with a spring to bear the file on the saw, as described."

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27. For an improvement in the *Propelling Power of Clocks;* Joseph Joes, Bristol, Hartford county, Connecticut, February 24.

This improvement is for so connecting a spring with the barrel of a clock by means of bent levers, as to increase the leverage in the ratio of the decrease of the tension of the spring as it runs down, and thus keep up an equal power.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of equalizing the tension of the cord or chain of the barrel by the combination of the lever, link, and spring, whether constructed and arranged precisely in the manner described, or in any other mode substantially the same.

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28. For an improvement in *Cast-Iron Pipe Boxes for Carriage Wheels;* John Huntington, Zanesville, Muskingum county, Ohio, February 24.

The object of this improvement is to cast pipe boxes with a chilled surface by means of a metallic core made in sections that it may be removed from the inside of the box, and admit of the contraction of the metal in cooling.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode or manner of casting pipe boxes for carriage or other wheels, by the use of the segment core, constructed and arranged and used in the way described for chilling or hardening and finishing the interior surfaces of the boxes.

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29. For an improvement in the *Press for Cotton and other substances;* P. G. Gardiner, New York city, New York, February 28.

The follower of this press is operated by two toggle joints that are drawn together by a right and left hand screw driven by a belt from some first mover passing around a pulley on the screw, which turns in boxes that slide in guides, so that they can move freely up and down as the toggle joints are operated.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the guide carriages or indicators on each side of the pulley, with the *screw and lever power press* to prevent the lateral motion while it allows a free vertical action, all as above described."

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30. For an improvement in the *Puppet Valves of Steam Engines;* Samuel Talbot, Richmond, Virginia, February 28.

The patentee says—"The nature of my invention consists in pro-

viding and arranging in the centre of the main steam valves a small valve to be opened sufficiently in advance of the main valve, to allow the steam to fill the vacuum between the piston and head of cylinder, and thereby produce an equilibrium of pressure upon the top and bottom of the same, before the lifting rod acts upon it, thereby allowing it to be raised by an amount of power sufficient to raise the weight of the same.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the use of the small valves, operating in the centre of the main valves and by the same motions, substantially as above described; by which arrangement much of the power required to open the valves in the old way, is saved for the direct action of the engine."

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31. For a *Relief Spring for Ships' Cables, and other purposes in which it is required to overcome the momentum of heavy masses;* Levi Bissel, Brooklyn, New York, February 28.

The cable or other thing to be relieved from a sudden jar, is connected with a wedge which slides between two rollers, one of them being connected with the piston of a pneumatic spring, so that the wedge cannot slide without overcoming the pressure applied to the surface of the wedge by the spring.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the inclined plane, rollers, and spring, in the manner above described, for any of the above mentioned, or for any other purpose to which the same may be applicable."

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32. For an improvement in *Pumps;* Joseph H. Webster, St. Louis, Missouri, February 28.

This is for combining the double acting piston of section and force pumps with a slide valve provided with eduction and induction passages adapted thereto.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the double acting suction and force pump with one valve, constructed and operating substantially in the manner and for the purpose herein set forth."

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33. For improvements in machinery for making *Ropes of any length;* Edward S. Townsend, Palmyra, Wayne county, New York, February 28.

This patent is granted for improvements on a machine patented by Townsend and Durfee, on the 6th of January, 1831, noticed at page 315, of vol. vii of this Journal, second series, to which the reader is referred for a general description.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the spindle, the end of which is adapted to the reception of the strand for forming, with the sliding block or guide for winding on after the strand is formed as described, also the combination of the spindle, in the machine for laying the

rope, the end of which is adapted for receiving the rope while giving the after turn, with the sliding block for winding on the rope after it is laid, as described. This invention differs from Townsend and Durfree's reel, patented in 1830 or 1831 in the following particulars:—In the use of that reel it was necessary when a single length of the walk, or building, was spun in yarns, to lay the same into rope and reel the same before spinning a second length. In spinning a second length the threads or yarns were united to the several threads or yarns already finished, by splicing or spinning into them, and so a second part of the rope was made and reeled as before. By this process being repeated, the rope was made of the desired length, but could not be made *patent formed* without lacing or splicing in the strands of the threads or yarns."

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34. For an improvement in the machine for *Cutting Sausage Meat;* George A. Coffman, New Middlebrook, Augusta county, Virginia, February 28.

In this machine the operating cutters are arranged on a rotary shaft or cylinder and the cutters against which they act, project from an adjustable roller so that they can be set relatively to those on the cylinder by means of screws.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the adjustable vibrating roller of inclined blades with the revolving cylinder of cutters, arranged and operated in the manner set forth."

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35. For an improvement in the *Hemp Brake;* H. G. Gardiner, New York city, New York, February 28.

The patentee says—"The nature of my invention consists in combining with a hemp brake, formed similar to the common hand brake, a shaft having two or more series of cams thereon, and giving to said shaft a lateral motion at pleasure, so as to bring either of the cams into operation.

The object of this is to regulate the strength of the blow to suit the condition of the hemp, by sliding the cams or tappets.

Claim.—"What I claim as my invention, and desire to secure by etters patent, is the combination of a shaft, having two or more series of cams thereon, with a common hemp brake, such as is used by hand, said shaft having a lateral motion, so as to bring either of the said cams into action at will, the whole being constructed and arranged as herein set forth."

Improvements added to previously granted patents during the month of February, 1845.

1. For an improvement in the *Rake;* H. Haynes, Middletown, Vt., added to letters patent granted to him June 18, 1839; Feb. 12, 1845.

For a description of the original invention, the reader is referred to page 36, vol. xxvi, second series of this Journal.

Claim.—"What I claim as my invenion, and desire to have added to my letters patent, is constructing the rake with an additional head, placed in front of, and parallel to, the rear head, into which the ends of the wire teeth are secured, (as described in my former patent,) and coiling the pieces of wire of which the teeth are composed around the said additional head, and extending them down in front of the head in the form of a cruia-reversa, or modern scroll, forming the requisite elastic, curved teeth for raking the hay, as described."

Patent Re-issued for amendment in the month of February, 1845.

1. For improvements in the *Construction and Heating of Furnaces;* C. E. Detmold, New York city, New York, February 20.

This patent was granted on the 15th of July, 1843, and has not yet been reached in our list of arrears; but as a full account of this invention has been published at large in this Journal, by Mr. Detmold, we will simply insert the amended claims, on which the letters patent were re-issued.

Claim.—"I wish it to be understood, that I do not claim as my invention the employing of carbonic oxide gas in combination with heated atmospheric air, this being known as the invention of Wm. Von Faher du Faur, upon which this is intended as an improvement, but what I do claim as my invention is:

The combination of a reverberatory furnace having a deep fire chamber for the special purpose of generating combustible gases from any kind of fuel, as above described, with an arrangement of blow-pipes or other convenient apparatus through which continuous jets of highly heated atmospheric air are forced into the combustible gases in their passage over the fire-bridge, for the purpose of producing their perfect and rapid combustion, substantially as set forth in the above specification."

List of American Patents which issued in the month of January, 1842, *with Remarks and Exemplifications.* By CHARLES M. KELLER, late Examiner of Patents in the U. S. Patent Office.

1. For improvements in *Lamps;* Edwin B. Horn, Boston, Massachusetts, January 8.

The character or principle of the improvements secured by this patent is fully expressed in the following

Claim.—"I shall claim surrounding the wick chamber by the outer tube or casing which intervenes between it and the reservoir, said tube or casing being constructed so much larger in its interior diameter than the external diameter of the outer tube of the wick chamber, as to form a space between the two through which the air descends and passes into the inner tube of the burner to act upon the interior surface of the flame. Also, bending the button rod under the wick chamber, and continuing it upwards between the same and the external casing or tube, and combining said button rod, so arranged,

with a crank upon the end of a small horizontal arbor, the same being for the purpose of elevating and depressing said rod and button, the whole of the above parts being constructed and arranged substantially as herein above set forth."

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2. For improvements in *Window Blinds*; Garner Wilkinson, White Creek, Washington county, New York, January 8.

The slats of these blinds slide on two rods permanently secured to the top and bottom of the window frame, and their ends are connected together by joint links and intermediate rods, forming chains at the sides of the blinds, to permit the slats to come close together when the blinds are drawn up by a cord that passes from the top through a hole in the middle of each slat, and attached to a hook at the bottom, by which the whole is secured to the sill of the window.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the method above described of connecting the slats together by means of links and intermediate rods, so as to enable them to approach each other in drawing them up; and in combination with the above, I claim the method of fastening them by means of the hook attached to the lower slat and to the cords by which they are drawn up, all as herein above described."

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2. For an improvement in *Fastenings for Bedsteads;* James Knipe, New York, January 8.

The rails are fastened to the posts by screws and nuts, in the usual manner, but instead of the head on the screws, a washer and wedge pin are used, to facilitate the taking down and putting up of bedsteads.

The head-board is secured by letting the lower rail thereof rest in metallic sockets screwed into the post, and having thumb bolts on the upper rail that fasten against metal plates screwed into the posts.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of securing the posts and rails of bedsteads by means of the screw and nut in combination with the washer and pin, in the manner described. I also claim the mode of securing the head-board by means of the socket in combination with the plate and flush bolts, substantially as herein described."

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4. For improvements in *Reverberatory Furnaces;* Claude S. Quillard, Roudout, Ulster county, New York, January 8.

From the fire chamber of the reverberatory furnace, vertical flues are formed, through which the coal is fed, and in which it is prepared for combustion; between the two vertical feeders there is another flue, made pretty much in the form of an inverted funnel, for the purpose of supplying a portion of finely screened anthracite, to be dropped directly upon the burning coal, and which, spreading over its surface, will produce an immediate "blaze, or flashing up."

In front of the fire-chamber there are two ranges of flues furnished with registers, for regulating the supply of air. And for the purpose of removing the cinders, a set of pokers or a temporary grate is intro-

duced through the air flues, to support the charge of coal whilst the grate is removed to drop the ashes, cinders, &c.

Claim.—"I am aware that vertical feeders, in which the fuel to be burnt is brought into a state of ignition before it reaches the point where it is to undergo combustion, have been used for various purposes, and I do not, therefore, claim them as of my invention; but such feeders as those constructed by me, and herein described, have not been heretofore used in combination with a reverberatory furnace, or indeed with a furnace of any kind. I do claim, therefore, as of my invention, and desire to secure by letters patent, the constructing of a reverberatory furnace in which anthracite is to be used as fuel with vertical feeders, constructed with feeding and with a flashing flue, and arranged and combined with such a furnace, in the manner herein set forth. Secondly, I claim the combining with such a furnace, the draught holes furnished with registers or sliding plates, as described, and leading directly to the body of the burning fuel in that part thereof where the most intense heat is required. Thirdly, I claim the manner of clearing out the ashes, cinders, and other refuse matters by the aid of the forked or temporary grate bars inserted through the holes, in the manner and for the purpose herein described."

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5. For an improvement in *Spikes, Nails, &c.;* Wm. T. Steiger, Washington City, District of Columbia, January 8.

The nature of this improvement is fully expressed in the following Claim.—"What I claim as my invention and desire to secure by letters patent, is the screw form given to the angles of the body of the spikes, bolts, nails, &c., by twisting them in the manner herein described, or by any other means producing substantially the same results."

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6. For an improvement in the mode of *operating the Valves or Dampers of Fire-places or Grates;* Henry Batchelder, Beverly, Essex county, Massachusetts, January 8.

The damper or valve is hinged to the back of the fire-place and closes on to an inclined seat. To the lower face of this damper is jointed a link, which, in turn, is jointed to a nut that travels on a screw turning in appropriate bearings and provided with a key or crank handle, in front of the fire-place, so that by turning this screw, the damper can be moved to any angle desired, and there retained.

Claim.—"I claim operating or regulating an adjustable valve plate in the flue of a fire-place or grate, by means of an arm attached to the plate and a movable nut, said nut being moved forward and back on, and by means of, a revolving screw passing through the same, the whole being substantially as above specified, for preventing chimneys from smoking."

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7. For an improvement in the *Machine for working Butter;* Seth Bishop, Reading, Fairfield county, Connecticut, January 8.

A round tub is hung on a vertical shaft, so that it can be turned by

a pinion taking into cogs on its edge, and on the shaft of this pinion there is a wheel with beaters to act on the butter as it is carried around by the rotation of the tub. A "regulator," or paddle, is jointed to the machine, by which the butter is forced or directed against the beaters.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combining of a movable tub with a revolving beating wheel, together with a regulator for forcing the butter under the beating wheel, as herein described; the whole being constructed and operating in the manner specified."

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8. For an improvement in the art of *Casting Statues;* Lawrence Myers, Philadelphia, Pennsylvania, January 8.

The patentee says:—"My invention consists in making a model or pattern of wax, exactly corresponding with the object required to be cast, which I cover all over with a liquid blacking, composed of 1 pint of pulverized charcoal, 1 gill of rye flour, 1 gill of molasses, 1 gill of sour beer, which are to be well mixed together and then diluted with sufficient water to make it a rich liquid blacking, to be applied to the model or pattern several times, as the weight of the casting may require. While the blacking thus put on is moist I apply my facing sand to the model or pattern, thereby causing the sand to adhere more firmly to the blacking."

Claim.—"Having, since my invention of the wax model or pattern, as before described, been informed that a model or pattern of wax has been used in foreign countries, I claim only as my invention and desire to secure, at this time, by letters patent, the mode of preventing oxidation of the surface of the metallic casting, and obtaining a finer and smoother surface, and deliveration of the figure by means of the aforesaid compound, or any other substantially the same, applied to the wax model, in the manner set forth."

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9. For improvements in the *Machine for Cleaning Grain;* Geo. D. Waldo, Lockport, Niagara county, January 17.

The following claim so fully expresses the nature of the improvement patented, that explanatory remarks would be superfluous.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner of arranging the several tiers of vanes or heaters, one above another, in a vertical case, made in the form of the frustrum of a cone, so that the respective tiers shall increase in diameter in the descending series; and with the vanes of each successive tier in descending, breaking joints with, or standing behind the vanes in the tier above it; and this arrangement of the vanes I claim only as being combined in a machine in which the grain is fed in at the top and is discharged at the bottom, and which is otherwise formed and arranged as herein set forth. I also claim, in combination therewith, the employing of the wire gauze cap, for admitting the air and for preventing the grain from passing the opening in the middle of the bottom of the machine. I do not claim the giving an inclination to the vanes for the purpose of beating the grain upwards and thereby

retarding its descent, as in very rapid motions this would not be necessary, and when it is resorted to, such inclination is but slight; a little device has also been previously resorted to in some of the long vanes or beaters which have been employed in smut machines, their upper ends having been so inclined backwards."

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10. For improvements in *Furnaces for the Smelting of Metals*; Frederick C. Kropff, Philadelphia, Pennsylvania, January 17.

The nature of this invention is fully pointed out in the accompanying

Claim.—"What I claim therein as new and desire to secure by letters patent, is the manner of constructing a gas receiver near the top or tunnel head of a smelting furnace, by combining therewith a cylinder, around which a space is left constituting the said gas receiver, and from which the combustible gases disengaged from the fuel in the furnace are to be conveyed by a tube, or conduit, to undergo combustion where it may be required, the respective parts being arranged and combined substantially in the manner, and applied to the purpose, herein made known. I also claim the manner of constructing and arranging the cast-iron apparatus denominated the gas mixing apparatus, for duly mixing and combining the combustible gases with atmospheric air, such apparatus being combined with a steam engine furnace and boiler, or with whatever else it may be desired to heat, substantially as described. I do not claim the merely mixing or combining of the combustible gases with atmospheric air for the purpose of producing combustion, this being an operation well understood and frequently practised; but I limit my claim in this particular to the manner in which I have effected the object in the apparatus, or in one substantially the same. I also claim as a modification of the same operation and apparatus, the manner of employing the combustible gases for the heating of air for producing the hot blast, or for any analogous purpose, by means of such apparatus connected and combined with the gas receiver, constructed as herein described."

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11. For a machine for *Hulling and Cleaning Clover-seed*; Peter Cook, Westfield, Chautauque county, New York, January 17.

This machine consists of two parallel cylinders of unequal diameters, whose surfaces are provided with points; one of them works in a concave below it, and the other in one above it, and extending under it. The clover seed is fed to the first cylinder, and from this it passes to the second, and is discharged therefrom, at the bottom, on to a shoe provided with several screens, and as the seeds pass through these screens, the chaff is blown away by a rotary fan blower.

Claim.—"What I claim as my improvement and invention and desire to secure by letters patent is the combining of two hulling cylinders, the concaves of which are arranged as set forth, (viz. under one cylinder, and above and partly surrounding the second cylinder) with a fan and shoe containing one or more screens, in the manner set

forth, said cylinders being placed in a horizontal position over the shoe, and constructed of unequal diameters, as described."

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12. For an improvement in the *Caps of Lamps;* Francis Draper, East Cambridge, Middlesex county, Massachusetts, January 17.

The lamp cap which we have here is made with a collar to fit inside of the neck of the lamp and to extend below it, so that when the lamp is tilted the oil shall not reach and pass through the screw, &c. of the wick tube.

Claim.—"I claim as my invention, the internal tube or collar applied to the cap of a lamp and extending downwards through the neck of the oil chamber, the same being constructed substantially in the manner and for the purpose herein above set forth."

ENGLISH PATENTS.

Specification of the Patent granted to JAMES GRAHAM, *of the county of Middlesex, for improvements in the manufacture of Zinc, Antimony, and Brass, in casting brass, and in apparatus for making pots used in such processes.*—Sealed February 17, 1845.

These improvements relate, firstly, to applying certain apparatus to effect more advantageously the condensation of the zinc.

Secondly, to a certain arrangement in the construction of part of the pipe through which the distillation of the zinc is carried on, so that a considerable saving of labor is effected, and likewise the chance of loss from the negligence of the workmen in performing such labor is avoided.

Thirdly, to a certain method of tapping pots containing molten zinc, antimony and brass, whereby the zinc is obtained with greater purity than by the method usually adopted; and a considerable saving in fuel results in the melting of the metals; and

Fourthly, my invention relates to an apparatus for ramming the material when making pots used for the purposes above-mentioned. And in order that my invention may be fully understood and readily carried into effect, I will proceed to describe the means pursued by me.

The first part of my invention I perform in the following manner: The lower ends of the descending pipes from the pots used in the manufacture of zinc are to be placed four to six inches under water and a suitable outlet for the gas or gases is to be formed, by which means the zinc is condensed more effectually. The immersion of the tube in water would, if alone resorted to, leave no exit for the gases generated, and consequently there would be such a pressure on the pots as would either burst or break them, or blow the water out of the ends of the pipes and vessels; to avoid this, I insert in the said pipe between the surface of the water and the underside of the brickwork of the furnace described in the specification of my former patent here-

inafter referred to, a gas burner, with a cock, through which the gas or gases are allowed to escape, and I light and thus burn such gas or gases; and they burn with more or less intensity according to the rate of reduction of the metal, thereby serving, not only as a criterion of the progress of the operation, but also as a means of saving and condensing the fine metal. By these means air will be prevented from coming in contact with the zinc vapor or the zinc in the descending tubes, and at the same time, the pressure being removed, the fine metal is preserved from oxidation and collected in the shape of finely-divided metal, instead of a considerable portion burning away, creating waste, and producing a nuisance. Towards the end of this process I have found that the gas or gases do not come off in sufficient quantities to burn. I then close the cock of the burner, and remove a quantity of the water from the vessel into which the descending pipes enter so as only just to seal the ends of the pipes with water, and in order to prevent a vacuum, or partial vacuum, in the pots should the fire get low, or otherwise, I apply a light valve in the side of the descending pipe, opening inwards.

The second part of my invention I effect as follows:—In the manufacture of zinc I have for some time employed a lining of clay or earthen material to the upper part of the descending tubes, as is described in the specification of letters patent bearing date at Westminster, the 18th day of October, A. D. 1843, and granted to me for improvements in the construction of pots and furnaces used in the manufacture of zinc, and in other manufactures, and also improvements in the treatment of ores of zinc, in the process of manufacturing zinc, instead of the lining which was attached or fixed at the upper part of the descending tubes. I place in the descending tubes a movable clay pipe in order to line the same, by which the frequent labor of cleaning or scraping the descending metal tubes is dispensed with, it being only necessary to clean the movable clay pipe once or twice during the operation, and when the charge is exhausted the said movable clay pipe may be cleaned, or if not readily cleaned it may be broken, in order to separate the metallic zinc which will, to some extent, be found adhering to this inner movable clay pipe. The movable clay pipe I fix, by small clamps, at or near the bottom of the descending tube, or by any other appropriate means, allowing of the ready removal of such linings; and I would state in respect to this part of my invention that it is not new to line the descending tubes with clay pipes, I having, in my former specification, described the use of fixed clay lining, but I have since found in practice that it is desirable to have them readily removable.

The manner of performing the third part of my invention consists in using pots or crucibles (placed in a furnace somewhat similarly constructed to the one described in the specification of my former patent) of the capacity desired, having each a hole on one side, close to the bottom, into the pots or crucibles, such holes being closed with clay. When the granulated zinc, antimony, or brass above-mentioned is charged into these pots I close the top with a clay cover, which may be luted on or not. When the metal is melted it is to be tapped by

means of a drill, cutting away the clay at the holes, and the charge, or any part thereof may be run out into ingots, or cast, or otherwise, observing only with respect to zinc, that after the charge is ran out that which is left in the pot or crucible is to be stirred well round and round with a stick, or piece of wood, by which means the metal contained in the remaining portion will be liberated, and nothing will be left but oxide, which had better be removed before a fresh charge is put in. And it should be stated, that during the stirring, the hole is to be closed with clay, which is to be removed in order to run off the zinc which will have descended to the bottom of the pot or crucible. This furnace, as above stated, is to be constructed similar to those described in my former patent for making zinc; but in this instance there will be no pipes or tubes to the pots, but they will be heated and otherwise arranged like that furnace, leaving holes through the furnace for tapping the holes in the pot, which holes in the furnace will be closed with bricks till the tapping is to be performed.

In making antimony I charge the pots with crude antimony, or the ore free from stones, as is well understood in charging movable crucibles, and when the charge is done the pots are to be tapped by a drill, as explained.

In my said former specification I described a means of making pots, and pointed out how the material, of which the pots were composed, was to be rammed, since which I have materially lessened the labor of ramming, by having a cylindrical rammer large enough to fit the interior space where the plastic materials are introduced between the staves or parts of the mould and the core, such cylinder being, however, capable of rising freely up and down within such space, and the lower edge of the cylindrical rammer is made rough, or is formed with projecting teeth to penetrate the clay. The rammer is made of metal, and is raised by means of a rope passing over a pully, and the rope descends to a treadle, by which a workman may raise the rammer and let it descend quickly; by this arrangement the work will be more uniformly rammed, and be performed at less cost.

And now having described my said improvements, I would wish it to be understood that what I claim as my invention is,

Firstly, the improvement in the manufacture of zinc, by allowing the escape from an outlet, as above described, of the gas or gases generated during the process of reducing zinc, the descending pipe being sealed or closed by immersion in water, and contact of the atmospheric air with zinc or zinc vapors being prevented.

Secondly, the improvement in the manufacture of zinc, by lining the descending pipe or tube with a movable clay pipe, for the purpose of avoiding the frequent cleaning of the descending pipe or tube.

Thirdly, the melting of zinc, antimony, and brass in pots or crucibles, provided with holes close to the bottoms, as hereinbefore described, and by tapping such pots by means of a drill or otherwise.

Fourthly, the using of a cylindrical rammer and apparatus, as herein described, when making pots for the purposes above-mentioned.—[*Inrolled August* 17, 1845.]

Rep. Pat. Inv.

Specification of the Patent granted to DAVID METCALF, *of Leeds, in the County of York, for a Mode of Manufacturing or Preparing a New Vegetable Preparation applicable to Dying Blue and other Colors*—Sealed November 21, 1844.

My invention of a mode of manufacturing or preparing a new vegetable preparation applicable to dying blue and other colors, consists in subjecting the leaves of a certain plant hereafter to be described to the same process of manufacture or preparation as has been heretofore applied to the leaves of the woad plant in order to fit them for the dyer's use. The plant thus to be substituted for woad is that which is sometimes called "succory," but is more commonly known in commerce by the name of "chicory." In order to obtain the said new vegetable preparation applicable to dying blue and other colors, I manufacture or prepare the leaves of the chicory plant in manner following:—

I first grind or crush them in a mill just such as is ordinarily employed in the preparation of woad. I then form the granulated mass into balls, which, when sufficiently dried, are broken into small pieces and subjected to the fermenting process called couching, after which the article is ready for the dyer. In some cases the leaves of the chicory plant are sufficiently dry after the first grinding to be subjected at once to the couching process; in such cases I proceed without the delay occasioned by the preparatory drying. In this way I obtain a new vegetable preparation applicable to the dying of blue, and of all other colors to which woad is applicable. I would here remark that I have not found it necessary to set forth any more in detail the precise nature of the apparatus and process used in the manufacture or preparation of the leaves of the chicory plant, because I employ the same apparatus, and subject them to the same process as are well known in the manufacture or preparation of the leaves of the woad plant.

Having thus described the nature of my invention, and the manner in which the same is to be carried into effect, I desire it to be understood that what I claim under the above in part-recited letters patent is the manufacture or preparation of the leaves of the chicory plant in the manner above described, for the purpose of obtaining a new vegetable preparation applicable to the dying of blue and of all other colors to which woad is applicable. [*Inrolled May*, 1845.

Ibid.

Important Case of Infringement of Patent.—Newton vs. the Grand Junction Railway Company.

This was an action to recover compensation from the company for the alleged infringement of a patent taken out by the plaintiff on the 15th of May, 1843, for improvements in the bearings of the axles of railway carriges, and other axles where great friction existed. The

invention purported to have been a communication from a Mr. Isaac Babbitt, an American, from Boston. Mr. Babbitt was in Liverpool in the year 1843, and had permission from the Liverpool and Manchester Railway Company to make experiments on two of the engines on their line. The result was satisfactory, and he afterwards sold the discovery to the present plaintiff.

A great mass of evidence was adduced, to show the nature of the invention, its novelty, and the importance of the results in diminishing the wear and tear of locomotive engines. It appeared that the invention consisted in lining the semi-circular brass "step" of the axle, which rested on the axle, and bore the weight of the carriage, with an alloy of a softer metal, of considerable thickness, which was prevented from spreading and yielding to the pressure by a brass fillet along its edge. The step was lined by first polishing the inside, tinning it, and then placing within it a mould the size of the axle or "journal," as it was called, running in the alloy while in a state of fusion. This alloy in cooling adhered to the tin and became incorporated with the brass step, fitting closely to the journal or axle which revolved in it.

A great number of witnesses were called to prove the advantage of this arrangement, in diminishing friction, in preventing the heating of the axles, in needing a smaller supply of oil, and in enabling the bearing to run for a much longer time without the necessity of renewal or repair.

Mr. Fothergill, foreman to Messrs. Sharp & Co., stated that he had for many years been employed in the manufacture of railway carriages, and that this improvement was new to him until the appearance of the patent in 1843. It was a very great improvement, and extremely useful in diminishing friction and preventing heating.

On cross-examination he stated that he had previous to that time known tin and lead used to repair old brasses when they had ceased to fit from wear, and there was not time to substitute a new one. The lead or tin was run in to make it fit until a new one could be supplied. He had known various bearings of solid block tin used, but they did not answer.

Mr. Robert Stephenson, C. E., gave similar evidence as to the utility of the invention. He said if the inside of the bearing were merely tinned, it would prevent heating, and in that thin coating would not spread by pressure. It would wear out sooner, and the fillet in the plaintiff's invention was useful in enabling them to run in a mass of alloy in a melted state, which coated the step to a considerable thickness without spreading by pressure, as it would do without the fillet.

Mr. John Fairburn, engineer at Manchester, gave similar statements as to the utility and novelty of the invention. He stated that he had known block tin and various alloys used for bearings, but always in a solid block. The novelty was in having an outer case and running in the alloy.

Mr. Thomas Wilkinson, foreman to Messrs. Bolton & Watts, Soho works; Mr. Jones, Clerk to the Liverpool and Manchester Company,

near Newton, and others, were examined. Their evidence was to the same effect.

Mr. Michael Allison, out-door foreman of the locomotive department to the Liverpool and Manchester Railway Company, stated, that there had been a very great and marked improvement in the running of the engines since the introduction of this invention. The Kingfisher, the Heron, and the Ostrich were fitted up with these bearings. Formerly the brass bearings on the old construction would run from 400 to 1,000 miles. They would run, when fitted up pursuant to the patent, from 4,000 to 10,000. The Kingfisher had run 20,000, and the bearings were still in good condition. A bearing now produced had run 32,000 miles without repairs.

Mr. Benjamin Lewis; Mr. Edward M'Connell, engineer to the Birmingham and Glocester Railway Company; Mr. Benjamin Cubitt; Mr. Fernyhough, manager on the Eastern Counties line; Mr. Melling, engine-maker, at Rainhill, and others, repeated in a great measure what had been said by the other witnesses as to the novelty and the utility of the invention.

Evidence of the infringement of the patent was also adduced. It appeared that in the case of many of the old brass bearings, as well as in new ones, when put in for the first time, the workmen were in the habit of tinning the inside of the brass, heating it and then rubbing a stick of tin on it so as to cause it as much as possible to adhere. This had been pointed out to the directors on several occasions by their managers, and the results in preventing friction, and diminishing the expenditure of oil, were mentioned. A long correspondence between the plaintiff and the secretary of the company was put in and read, the plaintiff claiming compensation for the use of his patent.

In one of these letters the secretary, while he denied that the company was infringing the patent, added, that the use of the tinning, in the way described, was of very little benefit, and that they thought of abandoning it.

Mr. Wortley addressed the jury for the defence, and called a number of persons to show that at Nantwich, Bury, and other places, where the brasses used in cotton mills had become worn, or did not fit, it was very usual to run in a quantity of an alloy of tin.

Mr. Hodge stated, that many years before the existence of this patent, in 1829, he had made a lathe, being then resident in Cornwall, the bearings of which were provided with a fillet and lined with an alloy run in precisely in the manner described in the patent, the object being that which the patent proposed—the diminution of friction. There were then many bearings of the same kind in use in Cornwall. This lathe he afterwards took to London, and sold there. He had not heard of it since, and did not know that this improvement was then generally known. He afterwards made an experiment with a view to improved bearings for the axles of a saw-mill. The improvement was the making of three longitudinal grooves along the surface of the brass bearing, and filling them up with an alloy. Nothing further, however, was done in the matter. The witness afterwards went to America, from which country he had but lately returned.

Mr. Baines replied, commenting strongly on the conduct of the company through their officers, who, he contended, had sought to evade the plaintiff's patent, and to get the benefit of his discovery without paying him that reasonable remuneration to which he was entitled.

His Lordship summed up. He said the question for the jury would be whether the defendants had violated the plaintiff's patent by using the whole or any part of his invention. If a patent is granted for a new combination of things known before, that does not prevent any other party from using that which was old. There was no evidence that the defendants had used the whole of the plaintiff's invention in the steps with the fillets as described in the patent; but it seemed established that their servants took old and new brasses, and after tinning them in the usual way, had while the brasses were hot, with a stick of tin, laid on as much as they could to the extent of from the 16th to the 8th of an inch. Many of the brasses were new, and it was not, therefore, the mere patching of old ones. Was that substantially an adoption of any part of the patent?—had they, by thus laying on the tin, smoothing it in some cases with a soldering-iron, as described, obtained some portion of the benefit of the invention; and was that part new?

The jury, after being out a considerable time, returned a verdict for the plaintiff—Damages, £1000. Lond. Mech. Mag.

MECHANICS, PHYSICS, AND CHEMISTRY.

On the different varieties of Sugar, and allied substances, with reference to the practical application of their Optical relations.

By VENTZKE.

Translated from Erdman's Journal der Pract. Cheme, vol. xxv, p. 65, by J. C. Booth, and M. H. Boyé, and communicated to the Journal of the Franklin Institute, by Prof. R. S. McCulloh.

Continued from page 268.

II. *Practical Application to the Sugar manufacture.*

A. PREPARATORY EXAMINATIONS.—Many points have not been expanded in the foregoing, which may have some influence on questions to be solved, such as,

1. *Influence of temperature on polarization.*

The observation was often made, that in cane sugar solutions of 25 per cent. content, a considerable elevation of temperature has no influence on its deviation to the right. Now since a very concentrated solution of cane sugar diminishes considerably in specific gravity by heat, and since the influence of this diminution upon the polarization ought to be apparent, the following experiments were instituted on this subject and confirm the above conclusion.

a. A cane sugar solution of sp. gr. 1,343 at 17½° C. (63½ F.) gave a deviation with normal length of the stratum (= 234 Mm.) of 174°

to the right. The brass tube fig. 2 is used for this purpose, having an additional tube *d*, for receiving the expanded solution which is heated, say to 80°—85° C. (176° to 185° F.) notwithstanding this increase of temperature, no other deviation is observed as might have been conjectured; for it should be less for the diminished specific gravity.

In order to have a point of comparison, the above solution is heated to 85 C. (185° F.) = 1,306. By adding so much water that it has the same density at 17½° C. (63½° F.) and polarizing it in the same tube, it shows 156° to the right, or 18° less than a solution of 1,343, which had been brought to the density of 1,306, or had lost 0,037.

The tube could not be lengthened by the above temperature, more than 0·5 Mm. corresponding to an increase of deviation of some 0·3° which might be included in errors of observation with concentrated solutions.

The next question is how sugar with a deviation to the left would behave under such circumstances.

b. Such a solution may be prepared according to Mitscherlich's method by boiling cane sugar with tartaric acid for 2½ hours, and separating the acid with carbonate of lime. Let the sugar solution have a density of 1·245 at 18° C. (64·4° F.) so that it gives in the above tube a deviation of 49° to the left. Heated from 59° C. to 63° C. (138·2° to 145·4° F.) the deviation is 23° – 24° to the left, or 25 – 26° less than at 18° C. (64·4° F.) The specific gravity of this solution at 59° and 62° C., is 1,210 and 1,215. When it is diluted so as to show a sp. gr. = 1·212 at 18½° C. (63½° F.) its deviation is 36·2 to the left.

c. In order to submit a natural fruit sugar to the same process, and to ascertain also what influence is exerted by grape sugar, fruit sugar from honey is mixed with so much grape sugar also from honey that the rotation is still to the left. Let it have a density of 1,083 at 19° C., (66·2° F.) and show a deviation of –12°; and when heated to 60° C. (140° F.) of — 8°. The liquid at this temperature = 1·07 and when so far diluted as to be 1·07 at 18° C. (64·4° F.) the deviation was 10° to the left.

The results of these experiments render it probable, that according to *a*, in sugar solutions which polarize to the right, the smaller deviation produced by the diminished specific gravity is neutralized by heat; or in other words, heat is an equivalent for the content in active substance of the observed stratum diminished by expansion. The reverse takes place with sugar having rotation to the left. The influence of temperature is the more apparent, as it adds to the diminution produced by expansion, for

If in *b*, the expansion was	— 49°
it could only be reduced by mere expansion, to	36·2°
or only - -	12·8°

But the real diminution was 49 – 24 = 25° so that 12·2° remain for heat, or about an equal action to that of expansion, and — 49 — (12·8 + 12·2) = — 24.

It would therefore seem as if *heat alone* always produced rotation

towards the *right*, which is in a certain ratio to the diminution of rotation produced by expansion, so that the heat-rotation in circular polarization is *neutralized* towards the right and doubled towards the left. In the latter case it is important in observations, in the former it disappears altogether.

It therefore may be assumed at present for all practical purposes, that with saccharine mixtures which rotate to the right, the temperature during the observation may be wholly disregarded.

But it is different in the determination of the density of sugar solutions. For, in order to obtain results that may be relied upon, we must always have a uniform density as a basis, which is here assumed to be 1,1056 at 17½° C. (63½° F.) (25 per cent. sugar content.) The temperature may vary between 8° C. and 28° C. (46·4° and 82·4° F.)

The following table shows what density the normal liquid would have at these temperatures.

TABLE A.

C	F	Density	C	F	Density	C	F	Density
28°	(82·4°)	1·1028	21°	(69·8°)	1·1048	14°	(57·2°)	1·1064
27°	(80·6°)	1·1031	20°	(68·0°)	1·1050	13°	(55·4°)	1·1066
26°	(78·8°)	1·1034	19°	(66·2°)	1·1052	12°	(53·6°)	1·1068
25°	(77·0°)	1·1037	18°	(64·4°)	1·1055	11°	(51·8°)	1·1070
24°	(75·2°)	1·1040	17°	(62·6°)	1·1058	10°	(50·0°)	1·1072
23°	(73·4°)	1·1043	16°	(60·8°)	1·1060	9°	(48·2°)	1·1074
22°	(71·6°)	1·1045	15°	(59·0°)	1·1062	8°	(46·4°)	1·1076

2. *Determination of Water and insoluble substances in Sugars.*

Cane sugar, &c. contain hygroscopic water and insoluble substances partly from sugar cane, party as accidental impurities. Can such a loss be determined by the hydrometer alone? Many comparative experiments made with very different kinds of raw sugar by determining the loss directly, and by the saccharometer, proved that the saccharometer would give a sufficiently accurate result for the manufacturer.

Thus a very brown crude sugar may give: Water, = 5·52 p. c.
Insolubles, = 0·33 "
Loss, 5·85 p. c.

The hydrometer indicates 6 per cent. which is probably more accurate than that ascertained directly.

In table B, one part of the testing sugar is supposed to be dissolved in 3 parts water. The table shows what percentage of dry sugar is contained in the test by means of the density and temperature ascertained at the same time.

In table C, 3 parts molasses in 7 water is assumed as the basis. The table gives the content of water in 100 parts of the molasses. It may also be employed, for sugar or molasses which has been concentrated to a certain point, and of which the content of water is required. If it is supposed to be under 14 per cent., it may be dissolved in the proportion as required by table B, and this used.

3. *The percentage of molasses sugar in mixture with cane sugar.*

Where molasses is boiled and the loss replaced by distilled water, it will not produce rotation to the left, even by a 40 hours boiling of a green bastard molasses which has therefore been boiled several times in the refinery. It exhibits no deposite of ulmic matter, nor can the presence of cane sugar be proved by treatment with chlorohydric acid, for the polarization remained = 0.

When still farther boiled, this molasses becomes cloudy with light brown ulmic matter, and exhibits a few degrees rotation to the right. Can it well be doubted, that here, as in many cases adduced by Soubeiran, molasses and fruit sugar (Soubeiran's Chylariose) were changed into grape sugar? A molasses boiled until it begins to rotate to the right will deposite crystals after some months: and when cane sugar is boiled 32 hours with water, so that the latter together with the formic acid produced, may condense and flow back, the whole mass after 4 to 6 weeks will become solid by crystalizing grape sugar mingled with fruit sugar. Mitscherlich confidently asserts that fruit sugar passes into grape sugar by boiling with sulphuric acid.

We must at all events suppose that if the formic acid remains in the liquid, it must exert some influence by contact similar to that of other acids. There is therefore nothing positive against the formation of a peculiar sugar incapable of polarization, which may be termed molasses or syrup sugar, and which according to Mitscherlich's supposition is produced when dry cane sugar is fused at 160° C. (320° F.) In this case it would be the product of the influence of heat without water; by boiling, the action of water is superadded without allowing the volatilizing acid to act with free access of air.

It may be assumed for the present, that all sugars and sirups occurring in a refinery for examination must consist mainly of mixtures of cane and molasses sugar, with a few coloring and nitrogenous substances and accidental impurities, and that the proportion of the two former to each other may be determined by polarization.

Another question must be determined whether molasses sugar, to which given percentage proportions of cane sugar have been added, causes the latter to rotate less to the right; and in the same proportions? Experiments made by mixing colorless molasses sugar of the normal density (1·1056) with cane sugar solution of the same density, so that the mass contained 20, 40, 60, and 80 per cent. of the latter, showed the right rotation, coinciding perfectly with the content of cane sugar.

The apparatus is arranged in such a manner that the percentage of cane sugar can be read off directly. As pure cane sugar rotates 56°, and sirup sugar = 0, there is fastened on the axis of the prism E' fig. 6, a wheel with 90 teeth, which is fitted to a pinion at the side with 14 teeth; when the latter makes one revolution the prism describes 56° of a circle for 14 : 90 :: 56 : 360. A disk L, is fixed on the pinion and divided into 100 degrees. The fixed index at L, points to the percentage of cane sugar corresponding to a certain rotation of the prism.

B. Examples of the Method of Observation.

1. *Green Sugar-house molasses or Bastard molasses.*

a. Weighing. The vessels for weighing are glass cylinders 10 in. high by 2 in. diameter, ground at top and covered with a ground glass plate, which may be fastened by a clamp and screw, so that the cylinder may be turned in any direction without spilling its contents.

We may determine before-hand, once for all, how far the cylinder would be filled with 100 grm, molasses, and mark it on the glass. The balance with 600 gm. weight should turn with a few mgrm., and the arms of the dishes should be some 15 in. long for convenience in filling.

To determine the quantity of water of the molasses the dried cylinder with its glass plate is weighed.

Suppose it to be - -	213·500 gm.
Filled to the mark with molasses it is now in gross	317·575 "
Therefore the nett weight of the molasses is,	104·075 "

According to table C, 7 water is added to 3 molasses 3 : 7 :: 104·075 : 242·841 gm. Water, = 242·841 gm.

The whole weight, therefore, to be laid on the balance is equal to 317·575 + 242·841 = 560·416 gm.

The best method of adding the water is to take about 5 gm. off the weights, then add nearly the quantity of water, and replacing the weights (5 gm.) to add the remainder by a pipette with a fine opening. It is much too inaccurate to add water by measurement.

The glass plate is set on, screwed fast and the cylinder shaken, until every particle of molasses is removed from the sides. The pasty lumps of crude sugar dissolve very slowly.

b. Determination of Water.—The hydrometer ranges from 1·0800 to 1·1100 and is so constructed that 0·0005 may be readily read from it, and the intermediate parts be approximately estimated; a Centigrade thermometer from 0° to 40° is also requisite; or Fahrenheit's from 32° to 104°.

When the air bubbles disappear from the solution by rest, the plate is removed and the hydrometer slowly let down into the liquid. It shows 1·0985. The temperature is also 21° C. (69·8° F.)

The table shows for	1·098	at 21° (69·8° F.)	21·7	per cent. water.
"	" 1·099	" "	20·9	" "
	Difference,		0·8	per ct.

For a ½ thousandth therefore 0·4 must be subtracted; or 21·7 — 0·4 = 21·3 per cent. for the content of water.

c. Determination of the Cane Sugar.—About 120 gm. of the molasses are dissolved in as much more water, and then decolorised, as above described. When the body is very dark, as in this case, the cylinder for discoloring should be 2 to 3 ft. long, by 1 in. in diameter. The normal density is attained by taking accurately the temperature and observing the density as given in table A, and adding water until the desired density is reached. Let it show a temperature of 22° C. (71·6° F.) then the density according to the table must be 1·1045.

The cylinder is covered with the glass plate to avoid evaporation when the tubes are not immediately filled.

As the hydrometer is frequently plunged into the liquid while reducing it to the standard density, it should each time be laid in water and wiped with a linen rag, as it might otherwise produce errors of several per cent.

The observation tube, fig. 3, of the normal length = 234 Mm. is filled with the prepared molasses solution, and attached to the apparatus, as above described. The comparing liquid of anilate of iron in the tube M, fig. 6, is also directed to the flame, and when at the distance of 4 in. to 6 in. we look through the prism E' and through M, with both eyes, then by turning the former to the right we can accurately produce in the observing tube the coloring of red, which coincides with the constant color in M.

The content of cane sugar may now be read off directly on the pinion disk L, fig. 6. It amounts to 60·75 per cent. of the dry substance. It was ascertained above, that this molasses contained 21·3 per cent. water, and therefore 78·7 of cane and sirup sugar together; 100 parts of dry substance contain as just determined, 60·75 per cent. cane sugar, and 39·25 of molasses sugar. Therefore the 78·7 of the two together

equal	47·81	cane sugar
and	30·89	molasses sugar
with	21·30	water
	100·00	

z. *Common Brown Raw Sugar.*

In examining every crude sugar, it is very important to get an average of the whole. To determine the content of water and insoluble matters, it is treated in the same way as molasses, only that 3 parts water to 1 sugar, are employed, or about 80 gm. of the latter.

Suppose the exact nett weight to be	78·380
We add of water (78·380) × 3 =	235·140

Let this solution show a density of 1·098 at 21° C. (69·8° F.) then table B shows at this temperature and density 94 per cent. sugar, so that the raw sugar contains 6 per cent. water and impurities.

In most cases the solution does not clear entirely by standing, little particles of the same spec. grav. as the liquid floating about in it; but these merely augment its volume without altering its density. An accurate result may be attained by letting it stand 24 hours before using the hydrometer.

The content of cane sugar is ascertained as with the molasses. Before decolorizing, the solution must be made perfectly clear, which if it cannot be done by filtration alone, must be effected by some fresh blood or beaten white of egg, for it is essential that the observations be made with a perfectly clear solution, since a trifling opalescence in a liquid of the thickness of 234 Mm. makes white light appear red, preventing the true determination of the proper tone of color.

Let the temperature at which the normal density is taken, be 13° C. (55.4° F.) Then the density according to table A, is 1·106. This liquid subjected to polarization shows

89 per cent. cane sugar
11 " molasses sugar } dry material.

Now the above sugar contains 94 per cent. dry crude sugar, therefore the crude sugar contains 83·66 per cent. cane sugar.
10·34 " molasses sugar.
6·00 " water and impurities.

100·

It may be asked how much molasses and sugar as commercial articles this sugar would yield. If the results of the above bastard molasses be taken, we have the following estimate.

The bastard molasses consisted of 39·25 per cent. molasses sugar.
and - 60·75 " cane sugar.

The above sugar contains 10·34 per cent. molasses sugar, which would therefore require 16 parts cane sugar to make the commercial molasses: for 39·25 : 60·75 : : 10·34 : 16·0. The proper proportion of molasses and sugar, is therefore obtained by subtracting the 16 per cent. from 83·66 per cent. and adding it to the 10·34, so that the proportion would be

67·66 Sugar
26·34 molasses } dry material.

By adding the 21·3 per cent. water to the calculation for making an ordinary molasses, we have 78·7 : 21·3 : : 26·34 : 7·13; so that 24.34 + 7·13 = 32·47 = equal the commercial sirup. The above sugar would therefore produce 67·66 per cent. commercial sugar.
33·47 pr. ct. " molasses.

Making 101·13 for every hundred crude sugar.

TABLE B.

Per centage of Cane Sugar—Specific Gravity.

Spec. Gravity	C 8° F 46·4	9° 48·2	10° 50·0	11° 51·8	12° 53·6	13° 55·4	14° 57·2	15° 59·0	16° 60·8	17° 62·6	18° 64·4	19° 66·2	20° 68·0	21° 69·8	22° 71.6	23° 73·4	24° 75·2	25° 77·0	26° 78·8	27° 80·6	28° 82·4
1·088	82·0	82·2	82·4	82 6	82·8	83·0	83·2	83·4	83·6	83·8	84·0	84·2	84·5	84·7	85·0	85·2	85·5	85·7	86·0	86·3	86·6
·089	83·0	83·2	83·4	83·6	83 8	84·0	84·2	84·4	84·6	84·8	85·0	85·2	85·5	85·7	86·0	86·2	86·4	86·6	86·9	87·2	87·5
·090	84·0	84·2	84·4	84·6	84·8	85·0	85·2	85·4	85·6	85·8	86 0	86·2	86·4	86·7	86·9	87·1	87·4	87·6	87·9	88·2	88·5
·091	85·0	85·2	85·4	85·6	85·8	86·0	86·1	86·3	86·5	86·7	86·9	87·1	87·3	87·6	87·9	88·1	88·4	88·6	88·8	89·1	89·4
·092	86·0	86·1	86 3	86·5	86·7	86·9	87·1	87·3	87·5	87·7	87·9	88·1	88·3	88·5	88·8	89·0	89·2	89·5	89·8	90·1	90·4
·093	86·9	87·1	87·3	87·5	87·7	87·9	88 0	88·2	88·4	88·6	88·8	89.0	89·2	89·5	89·8	90·0	90·2	90·4	90·7	91·0	91·3
·094	87·9	88·0	88·2	88·4	88·6	88 8	89·0	89·2	89·4	89·6	89·8	90·0	90·2	90·4	90·7	90·9	91·1	91·3	91·6	91·9	92·2
·095	88·8	89·0	89 2	89·4	89·6	89·8	89·9	90·1	90·3	90·5	90·7	90·9	91·1	91·3	91·6	91·8	92·0	92·2	92·5	92·8	93·1
·096	89 8	90·0	90·1	90·3	90·5	90·7	90·8	91·0	91·2	91·4	91·6	91·8	92·0	92·2	92·5	92·7	92·9	93·1	93·3	93·6	93·9
·097	90·7	90·8	91·0	91·2	91·4	91·6	91·7	91·9	92.1	92·3	92·5	92·7	92·9	93·1	93·3	93·5	93·7	93·9	94·2	94·5	94·8
·098	91·6	91·7	91·9	92·1	92·3	92·5	92·6	92·8	92·9	93·1	93·3	93·5	93·7	94·0	94·2	94·4	94·6	94·8	95·1	95·4	95·7
·099	92·5	92·6	92·8	93·0	93·1	93·3	93·4	93·6	93·8	94·0	94·2	94·4	94·6	94·8	95·1	95·3	95·5	95·7	96·0	96·3	96·6
1·100	93·3	93·4	93·6	93·8	94·0	94·2	94·3	94·5	94·7	94·9	95·1	95·3	95·5	95·7	96·0	96·2	96·4	96·6	96·9	97·2	97·5
·101	94·2	94·3	94·5	94·7	94·9	95·1	95 2	95·4	95·6	95·8	96·0	96·2	96·4	96·6	96·9	97·1	97·3	97·5	97·8	98·1	98·4
·102	95·1	95·2	95·4	95·6	95·8	96·0	96·1	96·3	96·5	96·7	96·9	97·1	97·3	97·5	97·8	98·0	98·2	98·4	98·7	99·0	99·3
·103	96·0	96·1	96·3	96·5	96·7	96·9	97·0	97·2	97·4	97·6	97·8	98·0	98·2	98·4	98·7	99·0	99·2	99·4	99·6	99·9	
·104	96·9	97·0	97·2	97·4	97·6	97·8	98·0	98·1	98·3	98·5	98·7	98·9	99·1	99·3	99·6	99·8					
·105	97·8	98·0	98·1	98·3	98·5	98·7	98·8	99·0	99·2	99·4	99·6	99·8									
·106	98·7	98·8	99·0	99·2	99·4	99·6	99·7	99·9													
·107	99·6	99·7	99·9																		

TABLE C.

Per cent. of Water—Specific Gravity.

Temperature.		1·080	·081	·082	·083	·084	·085	·086	·087	·088	·089	·090	1·091	·092	·093	·094	·095	·096	·097	0·98	·099	1.100	·101
C.°	F.°																						
28	82·4	34·4	33·6	32·7	31·9	31·3	30·4	29·6	28·7	27·9	27·1	26·3	25.5	24·8	24·1	23·4	22·5	21·7	21·0	20·2	19·5	18·8	18·1
27	80·6	34·7	33·9	33·0	32·2	31·5	30·7	29·9	29·0	28·2	27·4	26·6	25·8	25·1	24·4	23·6	22·8	22·0	21·2	20·5	19·8	19·1	18·4
26	78·8	34·9	34·1	33·3	32·5	31·7	30·9	30·1	29·2	28·4	27·6	26·8	26·0	25·3	24·6	23·8	23·0	22·3	21·5	20·7	20·0	19·3	18·6
25	77·0	35·2	34·3	33·5	32·7	31·9	31·1	30·3	29·5	28·6	27·8	27·0	26·2	25·5	24·8	24·0	23·2	22·4	21·7	20·9	20·1	19·4	18·7
24	75·2	35·4	34·5	33·7	32·9	32·1	31·3	30·5	29·7	28·8	28·0	27·2	26·4	25·7	25·0	24·2	23·4	22·6	21·9	21·1	20·3	19·6	18·9
23	73·4	35·6	34·7	33·9	33·1	32·3	31·5	30·7	29·9	29·0	28·2	27·4	26·6	25·9	25·2	24·4	23·6	22·8	22·1	21·3	20·5	19·8	19·1
22	71·6	35·8	34·9	34·1	33·3	32·5	31·7	30·9	30·1	29·2	28·4	27·6	26·8	26·0	25·3	24 6	23 8	23·0	22·3	21·5	20·7	20 0	19·3
21	69·8	36·1	35·2	34·3	33·5	32·7	31·9	31·1	30·3	29·5	28·6	27·8	27·0	26·2	25·4	24·7	24·0	23·2	22·4	21·7	20·9	20·1	19·4
20	68·0	36·3	35·4	34·5	33·7	32·9	32·1	31·3	30·5	29·7	28·8	28·0	27·2	26·4	25·6	24·9	24·2	23·4	22·6	21·9	21·1	20·3	19·6
19	66·2	36·5	35·6	34·7	33·9	33·1	32·3	31·5	30·7	29·9	29·0	28·2	27·4	26·6	25·8	25·1	24·4	23·6	22·8	22·1	21·3	20·5	19·8
18	64·4	36·7	35·8	34·9	34·1	33·3	32·5	31·7	30·9	30·1	29·2	28·4	27·6	26·8	26·0	25·3	24·6	23·8	23·0	22·3	21·5	20·7	20·0
17	62·6	36 9	36·0	35·1	34·3	33·5	32·7	31·9	31·0	30·2	29·4	28·6	27·8	27·0	26·2	25·5	24·8	24·0	23·2	22·5	21·7	20·9	20·2
16	60.8	37·1	36·2	35·3	34·4	33·6	32·8	32·0	31·2	30·4	29·5	28·7	28·0	27·1	26·3	25·6	25·0	24·1	23·3	22·6	21·8	21·0	20·4
15	59·0	37·3	36·4	35·5	34·6	33·8	33·0	32·2	31·4	30·5	29·7	28·9	28·1	27·2	26·5	25·8	25·1	24·3	23·5	22·8	22·0	21·2	20·5
14	57·2	37·5	36·6	35·7	34·7	33·9	33·1	32·3	31·5	30 7	29·9	29·0	28·3	27·4	26·6	25·9	25·2	24·4	23·7	22·9	22·2	21·4	20·6
13	55·4	37·6	36·7	35·8	34·9	34·1	33·3	32·5	31·7	30·9	30·1	29·2	28·4	27·6	26·8	26·0	25·3	24·6	23·8	23·0	22·3	21·5	20·7
12	53·6	37·8	36·9	36·0	35·1	34·2	33·4	32·6	31·8	31·0	30·2	29·4	28·6	27·8	27·0	26·2	25·5	24·8	24·0	23·2	22·5	21·7	20·9
11	51·8	38·0	37·1	36·2	35 3	34 4	33 6	32·8	32·0	31·2	30·4	29·6	28·8	28·0	27·2	26·4	25·7	25·0	24·2	23·4	22·7	21·9	21·1
10	50·0	38·1	37·2	36·3	35·4	34·5	33·7	32 9	32·1	31·3	30·5	29·7	29 0	28·2	27·4	26·6	25·8	25·1	24·3	23·6	22·8	22·0	21·3
9	48·2	38·3	37·4	36·5	35·6	34·7	33·9	33·1	32·3	31·5	30·7	29·9	29·1	28·3	27·5	26·7	25·9	25·2	24·5	23·7	22·9	22·2	21·4
8	46·4	38·5	37·6	36·7	35·8	34·9	34·1	33·3	32·5	31·7	30·9	30·1	29·2	28·4	27·6	26·8	26·0	25·3	24·6	23·8	23·0	22·3	21·5

TABLE C.—CONTINUED.

Per cent. of Water—Specific Gravity.

Temperature.		1·102	·103	·104	·105	·106	·107	·108	·109	·110
C.°	F.°									
28	82·4	17·3	16·6	15·8	15·1	14·4	13·7	13·0	12·3	11·6
27	80·6	17·6	16·9	16·1	15·4	14·7	14·0	13·3	12·6	11·9
26	78·8	17·8	17·1	16·3	15·6	14·9	14·2	13·5	12·8	12·1
25	77·0	18·0	17·2	16·5	15·7	15·0	14·3	13·6	12·9	12·2
24	75·2	18·2	17·4	16·7	15·9	15·2	14·5	13·8	13·1	12·4
23	73·4	18·4	17·6	16·9	16·1	15·4	14·7	14·0	13·3	12·6
22	71·6	18·6	17·8	17·1	16·3	15·6	14·9	14·2	13·5	12·8
21	69·8	18·7	18·0	17·2	16·5	15·7	15·0	14·3	13·6	12·9
20	68·0	18·9	18·2	17·4	16·7	15·9	15·2	14·5	13·8	13·1
19	66·2	19·1	18·4	17·6	16·9	16·1	15·4	14·7	14·0	13·3
18	64·4	19·3	18·6	17·8	17·1	16·3	15·6	14·9	14·2	13·5
17	62·6	19·5	18·8	18·0	17·3	16·5	15·8	15·0	14·3	13·6
16	60·8	19·7	19·0	18·2	17·4	16·7	16·0	15·2	14·4	13·7
15	59·0	19·8	19·1	18·4	17·6	16·9	16·1	15·4	14·6	13·9
14	57·2	19·9	19·2	18·5	17·7	17·0	16 2	15·5	14·8	14·1
13	55·4	20·0	19·3	18·6	17·8	17·1	16·3	15·6	14·9	14·2
12	53·6	20·2	19·5	18·8	18·0	17·3	16·5	15·8	15·0	14·3
11	51·8	20·3	19·6	18·9	18·2	17·5	16·7	16·0	15·2	14·5
10	50·0	20·5	19·8	19·0	18·3	17·6	16·9	16·2	15·4	14·7
9	48·2	20·6	19 9	19 2	18·5	17·7	17·0	16·4	15·6	14·8
8	46·4	20·7	20·0	19·3	18·6	17·8	17·1	16·5	15·8	15·0

Mineral Produce of South Wales.

On his examination before the committee of the South Wales Railway, Mr. Buckland stated that during last year, 220,000 tons of iron, and 600,000 tons of coal were exported from Newport, and from Merthyr to Cardiff no less than 180,000 tons of iron annually, and that this trade was increasing daily. From Newport and Cardiff, iron ores were exported in considerable quantities, and from the latter place there was a large export trade to Ireland. From Bristol and Gloucester there were exported to Cardiff, in the year ending June, 1844, 80,000 tons, and from Cardiff to the other ports, 10,000 tons, which did not include coals. The total quantity of iron produced during the year in the district was from 450,000 to 500,000 tons, which, at the low average of 1844, was, 4,500,000*l.* in value. The tin plates produced in that part only of the district through which the proposed railway would pass, was between 27,000 and 28,000 tons, over 800,000*l.* in value. There were 55,720 tons of copper ore imported into the country last year, of which 43,734 tons were smelted at Swansea, the total value of which was about 2,000,000*l.* The whole metallic manufacture of the district amounted in value in one year to between 9,000,000*l.* and 10,000,000*l.*, while there were large quantities of timber and charcoal produced in Herefordshire. Lond. Mining Jour.

Notice of the method of Puddling Cast-Iron at Montblainville, (Meuse,) by means of the combustible gases from a refinery fire.

By M. SAUVAGE, Engineer of Mines.

Translated for the Journal of the Franklin Institute, from the Annales des Mines.

The waste heat from refinery fires is successfully applied, in a great number of establishments, to various metalurgic operations, which do not require a very high degree of heat.

At the time when M. Ebelman devoted himself to the important researches, which he has published, upon the composition of the gases which are disengaged from these furnaces, some unsuccessful attempts had already been made to carry on the operation of puddling by their aid. But it attracted the attention of M. Ebelman that a current of hot air, projected at the same time, through several orifices, (such as is now used for the combustion of the gases of a smelting furnace,) had not yet been used to burn the gases from a forge fire.

This new application of waste heat has recently been the subject of numerous experiments at the works at Montblainville, and the operation of puddling is there practised in a manner sufficiently regular and advantageous to justify the belief, that it will be useful to publish the results. The refining fire, it is true, is not sustained by pure charcoal, but by a mixture of charcoal and a large proportion of baked or dried wood. The conditions, therefore, are not the same as in common refineries.

General arrangement of the Apparatus.

A, Is the refinery fire with two tuyers connected with one another.

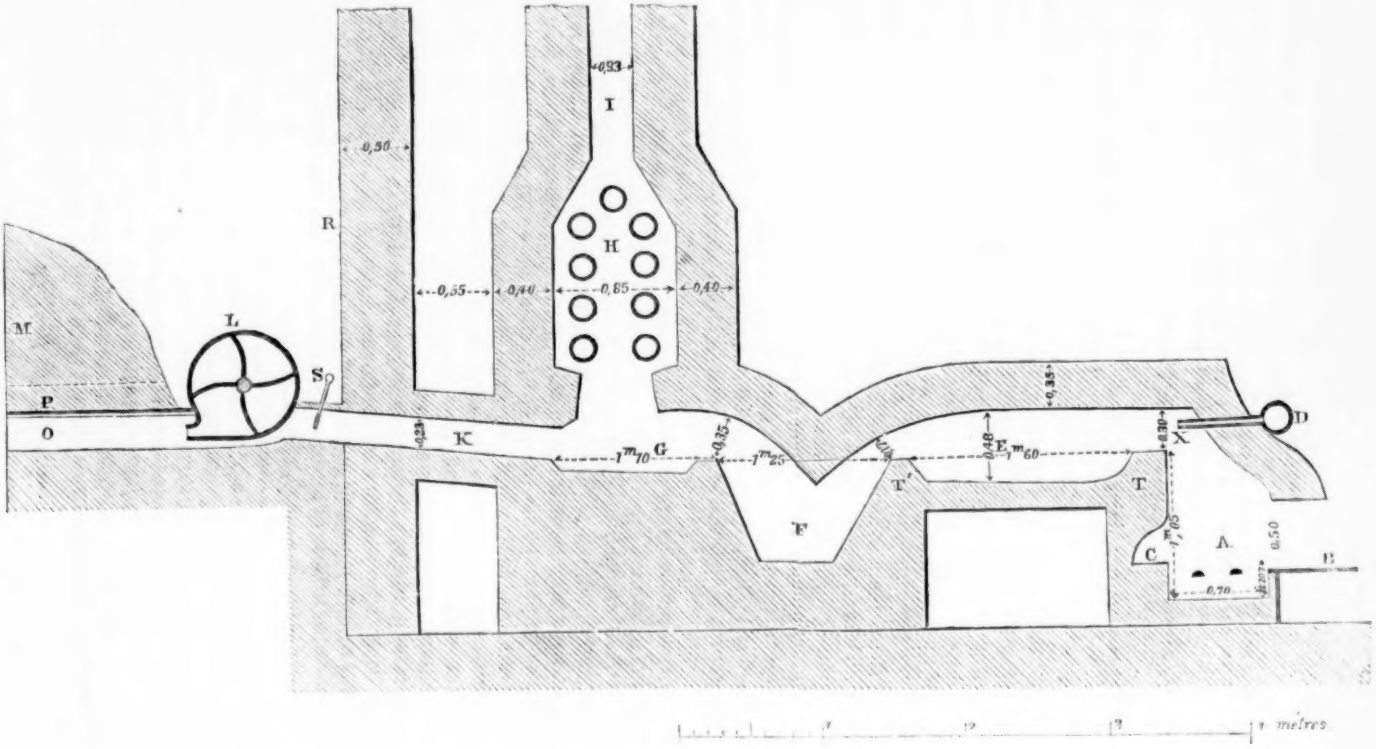
B, Working opening.

C, Small furnace for heating the cast iron to be converted into loupes in the refinery fire.

E, Puddling furnace into which the flame from the refinery fire passes, after going over the main bridge wall T.

D, Horizontal pipes which project air, previously heated to 300° C. (572° F.) into this flame, through 7 tubes or small tuyers, each 0·02 m. (0·79 ins.) diameter, arranged parallel to each other in the width of the furnace. This current of compressed hot air, burns the gases almost entirely in the space E, where the highest temperature is required. What escapes combustion passes with the other products of combustion, over the small bridge wall T, afterwards into the flue F, then serves to heat the cast iron for the next charge, and finally escapes through a low chimney (only a few feet higher than the roof of the works,) after having heated the blast in the apparatus H. This apparatus is arranged like that at Wasserhalfingin; it consists of nine straight pipes joined by elbows or bends; each pipe exposes 9·67 square feet of surface to the flame; seven of these pipes heat the blast for the puddling furnace, and the other two for the refinery fire.

A small part of the waste heat is drawn off through a brick flue K, by a fan made of cast and sheet iron, and is driven into a pile or heap of wood to dry or bake it, for the use of the refinery fire.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0,55
0,40
0,65
0,40
0,35
0,48
0,50
0,70
1m70
1m25
1m60
1m05
metres

Method of Working.

Refining.—The cast iron used comes from a smelting furnace supplied with dried wood and hot blast. The fuel is a mixture of nine parts by bulk of dried wood to one of charcoal. The wood is of various kinds, weighing in the forest, after being cut six months, from 2800 to 3000 lbs. per cord of 128 cubic ft. (350 to 375 Kil. la stere.) The product of the refinery consists exclusively of plough shares.

The refinery fire has two tuyeres of 0·985 ins. diameter. The mean pressure of the blast is 1·57 ins. mercury = 0·77 lbs. per square inch, and its temperature from 176° to 212° F.*

The manner of working is the same as usual; the workman charges with about 132 lbs. of cast iron previously heated in the furnace C; during the refining, properly speaking, he employs only dried wood, which gives to the refinery fire, a sufficiently high temperature for this phase of the operation, and to the puddling furnace a more abundant and longer flame than the charcoal will make. As soon as the loupe is taken out of the refinery fire to be shingled, the workman fills up the furnace with about (2·47 cub. ft.) 1½ heaped bushels † of charcoal, covers this over with a little dried wood, and then puts in a new charge of cast iron. The use of charcoal at this period of the operation, is indispensable, in order to be able to heat the loupe, which will be brought back after shingling, to a white welding heat.

The loupe is heated and drawn out under the hammer in the usual manner. The refining and drawing out of a loupe requires from one and a half to two hours.

Puddling.—The same cast iron is used in the puddling furnace as in the refinery fire. In commencing to work with the latter, the puddling furnace is gradually heated; the puddler prepares the hearth, and heats to redness a charge of from 374 to 440 lbs. of cast iron, in the furnace G. As soon as he judges that the furnace is sufficiently hot and that the hearth is ready, which is generally in about 4 or 5 hours, he places the cast iron which has been already heated to redness, in the puddling furnace, and puts another charge into the furnace G. The operation is afterwards conducted in the usual manner. The time required for one heat is about the same as for the refinery fire. The furnace works for 15 days without repair. The quality of the iron appears to be much superior to that made in the coal furnaces, under the same circumstances, and is more similar in this respect, to the iron made with wood.

* The formula $Q = 289\, d^2 \sqrt{\frac{h(1+0{\cdot}0037\,t}{b+h}}$, or converted into English measures, $Q = 948\, d^2 \sqrt{\frac{h\,(1+\frac{0{\cdot}00206\,(t-32)}{b+h}}{b+h}}$, gives when $d = 0{\cdot}082$ feet, $h = 0{\cdot}1312$ feet. $b = 2{\cdot}46$ feet, $t = 194°$ F. $Q = 1{\cdot}66$ cub. ft. per second, and for two tuyeres 3·32 cub. feet, at temperature of 194° F., and under a pressure of $b + h = 2{\cdot}59$ feet or 31·2 ins. mercury. The volume of air reduced to 32° F., add with the barometer at 29·85 ins. is 2·58 cubic feet, and per minute 155 cubic feet.

The velocity of the air per second is $\frac{1{\cdot}66 \times 4}{n\,d^2} = 312$ feet.

† Heaped bushel contains 2815·48 cubic inches.

Drying of the Wood.—The fan, 1, receives its motion from the wheel of the blowing machine, by means of a cord and pulleys. It draws part of the gases from the furnace, through the flue K, and forces them into a channel built of stone, from 20 to 23 feet long, one foot square in section, and built under the surface of the ground. This channel is covered with cast iron plates, 16 inches wide, raised about four-tenths of an inch above the vertical walls, in such manner as to cause the gases to escape at the sides horizontally.

The pile of wood to be dried, containing about 1400 cub. feet, or 11 cords, is arranged upon an eliptical base, of which the channel O, is the longer axis, and it is covered over with earth and cinders. The wood is placed so as not to touch the cast iron plates.

The speed of the fan, and the position of the small damper S, are so adjusted as to maintain the pile at a temperature of about 392° F. After three or four days the wood is dried; it loses about 25 per cent. of its weight, and 10 per cent. of its bulk, and the color becomes slightly brown. It is in every respect similar to that obtained by the Echrement process, which we have before described.—*(Annales, t.* xviii, p. 677.*)*

Consumption and Products—Comparisons.

From the 1st of September, 1843, to the 31st March, 1844, the refinery fire working in the old manner, consumed 167·810 Kil. = 165 tons of cast iron, and 1060 met. cub. = 23·002 heaped bushels of charcoal, of which one-seventh part is for loss in the store sheds (this loss is real, and is verified by the experience of several years.) It has produced 117¾ tons of plough shares, being 14·72 tons per month.*

The consumption for each ton of plough shares has been 1·4 tons of cast iron, and 195 heaped bushels of charcoal.

This consumption is great, but it should be observed that the plough shares when taken from the refinery fire are only "roughed out," and it is necessary to heat them again, in a heating furnace, before being plated out, from which another loss is sustained; but the calculation of the consumption, the refinery fire is based upon the weight after being plated out.

In April, this year, 1844, the apparatus was arranged as it is now; in May, June and July several changes have taken place in the work of the refinery fire, which has sometimes produced blooms (pieces cinglies) sometimes iron bars, sometimes plough shares; on the other hand the workmen have had to acquire experience in the new method; it is therefore impossible to have precise data for comparing the working of these four months with the preceding period.

In August, 1844, the working was altogether regular, and the operation quite complete; the refinery fire consumed:

21·017 Kil. = 20⅔ tons of cast iron,
29·03 mc. = 630 heaped bushels charcoal,
201·54 " = 4373 " " of dried wood.†
And produced 14½ tons of plough shares.

* This is an error, from 1st September, 1843, to 31st March, 1844, is but 7 months—the production was therefore 16·82 tons per month, instead of 14·72.—*Trans.*

† We use this unusual measure for wood in order that the relative quantity of wood and charcoal may be seen at a glance.—*Trans.*

The consumption per ton of plough shares (with the same workmen and same products as in the period from September, 1843, to March, 1844,) has therefore been:

14·25 Kil. = 1·42 tons cast iron,
1·97 mc. = 42·75 heaped bushels of charcoal,
13·67 mc. = 296 heaped bushels of dried wood.

During the same month (August, 1844,) the puddling furnace consumed 58 tons of cast iron and produced 51·9 tons of blooms. That is for each ton of blooms, 1·118 tons of cast iron, a great consumption occasioned by the use of a considerable proportion of burnt and oxidized cast iron scrap. The usual rate of working (in July, 1844, for example,) does not exceed 1·09 tons of cast iron, which is the same proportion as in puddling furnaces with coal.

From a comparison of the work during these two periods, the following conclusions are drawn:

1st. The monthly production of the refinery fire was 14·72 tons.
It is now only - - 14·50 "
Difference, 0·22 "

which is insignificant, and will disappear when the workmen have more experience.

2nd. The consumption of cast iron is increased 63 lbs. which may be represented in money, by $0·68.

It may happen that this increased consumption is due to causes foreign to the introduction of the new process. Thus the refinery fire is now at a distance from the hammer, and therefore disadvantageous for working.

3rd. The consumption of charcoal was 192 heaped bushels, weighing 20·27 lbs. per bushel, or 3894 lbs.; and as the wood of this neighborhood yields about 7·6 lbs. of charcoal per bushel, this consumption corresponds with that of 512 bushels of wood. It includes, as we have already said, a loss of one-seventh, so that the effective consumption of the refinery fire is, 3894 lbs.

Less---one-seventh 556 "

Or - - 3338 "

and of wood $\frac{3338}{7·6}$ or 439 bushels.

From the actual working the consumption is—

1st. 1·90 mc. or 41·23 heaped bushels of charcoal weighing 836 lbs. and corresponding to - 110 bushels of wood.
and 2nd. 13·67 mc. or 306⅔ heaped bushels of dried wood, produced by 329·8 " "

Total, 439·8

To obtain the effective expenditure of the refinery fire, one-seventh of the whole weight of charcoal used must be deducted, that is, $\frac{836}{7}$

or =119·4 lbs., corresponding to 15·6 bushels. The total consumption is therefore 424¼ instead of 439 bushels.

The substitution of dried wood for charcoal seems to give a trifling economy of fuel, (14¾ bushels.) Nevertheless, this economy is really greater than the results of the preceding calculations seem to indicate. In effect, although the flame of the refinery fire is sufficient to maintain, almost constantly, a suitable temperature in the puddling furnace, it is certain that during the period of "letting or cooling down," which precedes the withdrawal of the loop, the refinery fire might become very low if it were used for no other purpose; therefore, the fuel that is added at this time to prevent the cooling of the puddling furnace, should be charged to the latter. It is an extremely difficult matter to determine, exactly, the relative quantity. Messrs. Bellevue and Lovat, who have placed me under the greatest obligations by furnishing this information, and whose accuracy may be relied upon, estimate it at $\frac{1}{7}$th of the whole consumption, or 60·68 bushels. This quantity, added to 14¾ bushels, represents the total economy of fuel.

In order to appreciate the proportion of heat lost to that which is used in the refinery fire, it should be considered that the latter produces generally 94·6 lbs. iron in 1·75 hours, consuming during this time 18·22 bushels of wood, or 10·4 bushels per hour, capable of developing about 3600 "calories"* or units of heat per kilogramme; or in English terms, each pound of wood is capable of heating 6480 lbs. of water one degree Farenheit. The total number of English units is, therefore, 6480 × 10·4 multiplied by the weight of a bushel of dried wood, 28·4 = 1893932. During the same time, (one hour and three-quarters) the puddling furnace has produced about 330 lbs. of iron, which, by the ordinary treatment, would require the use of 214½ lbs. of coal, that is, per hour, 122½ lbs. But a kil. of coal can develope 7·500 French calories, (units of heat,) or in English terms, 1 avoirdu. developes 13·500 English units; these 122½ lbs. will give 1653750 units of heat, or 85 per cent. of the value of the combustible used. This comparison, moreover, is not strictly correct, because the waste heat which escapes from a furnace burning 121 lbs. coal per hour, is incomparably greater than that which the combustible gases of Montblainville possess when they come out of the apparatus, although the latter is still sufficient to heat the air and char the wood necessary for the working of the refinery fire.

If the question be now considered financially, which, after all, is the most important, we see that formerly the consumption was 192 heaped bushels of charcoal, at 11¼ cents, $21·75

It is now 42·75 bushels of charcoal, at 11⅓ cts. per bushel, $4·84

And 296 heaped bushels of dried wood, at 5·53 cts. per bushel, 16·36 = $21·20†

Apparent economy, 0·55

* The French unit of heat is one kil. of water heated 1° Centigrade; this corresponds with 3·968 avoir. lbs., heated 1° Fah.

†*Price of Charcoal.*—3·575 cords, or 282 heaped bushels of wood at $2·38 per cord, were

From the supposition that $\frac{1}{7}$th of the expense, $\frac{\$21{\cdot}20}{7} = \$3{\cdot}03$, should be charged to the puddling furnace, we should only reckon $18·17 to the refinery fire, and a saving of $3·58 per 1000 kil., or 3·64 per ton should be attributed to the substitution of dried wood for charcoal.

As the puddling produces about 3½ times as much iron as the refinery fire, in the same time, the expense of $3·03 only adds 0·86⅓ cents per ton of puddled iron.

The puddling furnaces of Montblainville, which have been idle for some time in consequence of the high price of fuel, do not use less than 1430 lbs. of Liege coal of good quality for each 1000 kil. of blooms, or 1453 lbs. of Liege coal per ton. The Belgian coal costs now 7.62 per ton, delivered at Montblainville; the 1453 lbs. will come to $4·96. The nett saving is, therefore, $4·96 less 86⅓, or $4·10 per ton.

To recapitulate, the economical results are,—

1st. For the refinery fire, $3·64 per ton, and per month on 14½ tons,	$52·78
2nd. For the puddling furnace, $4·10 per ton, and per month on 51 tons,	209·10
Monthly economy,	$261·88

Expenses of the Construction and Establishment of the Apparatus.

The puddling furnace of Montblainville differs from an ordinary furnace only in the substitution of the refinery fire for the grate, the suppression of the large chimney, and the addition of a hot air apparatus.

The construction of this apparatus may be valued at from 75 to 100 dollars. The two fans, and the plates over the flue walls, might cost about as much more, making the total expense in ordinary cases from 150 to 200 dollars; which expense is in part balanced by the saving from the suppression of the high chimney for draft.

An establishment which would use three refinery fires and a pair of rolls, could have a complete system of puddling and rolling, or drawing out. One of the fires would serve to heat a furnace for re-heating the iron, which would come from the other two. The experiment of re-heating has been successfully made at Montblainville, by the temporary conversion of a puddling into a welding furnace.

charred in the forest,	$8·53
The cost of charring amounted to	·56
Transportation,	·75
Total,	$9.84

The product obtained was 87·0 bushels of charcoal, costing, therefore, 11⅓ cents per bushel.

Price of Dried Wood.—There was dried 0·55 cords, or 43·4 bushels of wood, at $2·38 per cord,

	$1·31
Drying at the works, at 9 cents,	·18¾
Transportation,	·23¾
Sawing,	·18¾
	$1·92

And 39 bushels or 0·49 of a cord of dried wood was obtained, the cost was, therefore, $3·92 per cord, or 49¼ centsper bushl.

Account of the various Improvements made in the Stocking Frame from its invention to the present day, and its connexion with the Lace Manufacture.

[From the Report of the Commissioners appointed to inquire into the condition of the Frame-work Knitters, 1845.]

In a memorial addressed to the Lords of the Treasury in 1834, against the exportation of machinery, from the merchants, manufacturers, and others at Nottingham, engaged in the manufacture of silk and cotton bobbin-net lace, the introduction and importance of this manufacture is thus spoken of:—

"The fabrication of thread and silk lace is a very ancient and extensive manufacture, the manner of making which, by the hand, is a very complicated, tedious, and slow process, and, of consequence, such lace is very expensive and costly.

"That the manufacturers of such lace, particularly of the most costly fabrics, principally resided in the northern provinces of France, in Brabant, Flanders, and the Low Countries, where the female population were to a great extent employed in making lace.

"That although the making of the inferior kinds of lace was extensively carried on in the counties of Buckingham, Bedford, and Northampton, and the superior fabrics to a small extent in Devonshire, yet such was the demand for foreign laces in these dominions, that Parliament was induced to prohibit the importation of such laces, as it caused a visible diminution in the amount of British specie, and weakened the resources of Britain, whilst it added to the power, wealth, and aggrandizement of France, and the possessors of the Low Countries.

"That the superseding of hand labor by machinery, in the carding and shearing of cotton and other cloths, had been early invented in England, and the use of such carding machinery was prohibited (by the 5th and 6th of Edward VI., cap. 22,) on account of its damaging the cloth in the process, from the imperfection of its construction; so that the knitting or stocking frame was the first invention successfully used for superseding hand labor by the use of a machine, in making clothing.

"That in the latter end of the reign of His Majesty George II., or about 150 years after the invention of the said knitting machine, a number of appendages were applied to the said stocking frame, one of which, termed the tickler machine, by mere accident, was applied to the making fabrics in imitation of lace, by removing the stocking loops in various directions. This attempt was succeeded by another invention, termed a point-net machine, consisting of a machine appended to the frame, which made the net without removing the stitches; and this invention, after numerous attempts to make it sound, nearly superseded the making of silk lace by the hand.

"Your memorialists further show that this net, though an imitation of bobbin-lace, was yet inferior in many essential points to those fabrics, particularly in retaining its appearance of lace, when unstiffened;

notwithstanding which defect, no less than 1200 workmen were employed at one period in making it, and more than 20,000 persons in ornamenting the net, and preparing it for sale.

"That so early as the year 1770, attempts were made to produce bobbin-nets by machinery, in exact imitation of those made by the hand, having the threads traversed and twisted round each other. To accomplish this object a machine was invented to plat a warp at both ends, in imitation of a machine brought from Switzerland, but this was found too slow a process; small brass winding bobbins, having teeth, and rolling in other rack teeth were essayed; threads wound upon wire, tier upon tier of hooks, revolving wheels on slides, and hundred of other experiments were tried, and though the bobbin mesh was by these means effected, yet the want of speed and accuracy of working rendered all the plans abortive. Numerous attempts were made during this period in Scotland, London, and many parts of the kingdom, to make fishing-nets by machinery, which was for several years also essayed at Nottingham. A workman employed in making and inventing such machinery, at length discovered, through accidentally seeing a child at play, the formation of the bobbin and carriage now used in the bobbin-net machine, which was first applied to the making of fishing-nets. Notwithstanding this discovery, none of the inventors could apply it to a machine to make bobbin-net. So great was the difficulty, and such the number of abortive attempts, that the projectors were ranked amongst the enthusiasts who were seeking to obtain the perpetual motion. Two men, named Simpson and Green, actually died from a disease of the brain, brought on by unremitting and unrequited study.

"At length, in 1809, a machine to make bobbin-net was completed, which had passed through the hands of no less than six of the most ingenious and indefatigable mechanics then known, whose labors had been abortive, though they had passed their lives in similar attempts.

"The machine thus accomplished, after 40 years' experiments in different parts of the kingdom, was yet surprisingly complex and slow in its movements, having 24 motions to the series for twisting the mesh, and four motions for the pins to secure the twist from unraveling.

"This complex machine, before the expiration of the patent, was simplified so as to require only 13 motions to complete the same mesh, and two to prevent the unravelment; two other improvements reduced the motions to 11, and two motions for preventing the unravelment; and at length the utmost acme of speed was accomplished, by reducing the motions to six, and performing the two motions to prevent unravelment at the same time that the other motions were made; whilst a number of machines to any extent were constructed, so as to be propelled by steam and water power. The original machine only possessed speed sufficient to make one rack, of 240 holes in length, in an hour, while the power-impelled machines can make six such racks in an hour; in addition to which, the original machines made nets from one yard to one yard and a half in width, whereas machines are

now made to fabricate net, three, and even four yards in width, thus increasing the speed of the machinery twelvefold.

"To accomplish these surprising improvements, one gentleman has expended the whole of his property, amounting to from 50,000*l.* to 70,000*l.*, whilst others have made similar sacrifices, in proportion to their means.

"That in addition to the improvement upon the principle of the original machine, other modifications of the principle of making bobbin-nets, by the bobbin and carriage, have been accomplished:—by traversing the warp instead of the bobbin-thread; by placing the carriages in a single line, instead of a double line, as in the original invention; all of which improvements or modifications have been made with an immense outlay of capital, and by intense study, care, ingenuity, and perseverance. That in addition to which, though the original machine was only calculated to make plain net in a broad piece, unornamented, yet, by the application of unceasing ingenuity, regardless of expense, various ornaments have been worked into the net by machinery, whilst the net, instead of being made in broad pieces, is worked into slips, exactly imitating the cushion net. The result of making such lace by machinery has been to reduce the foreign cushion lace workers to less than a tenth in number, and England has become a great exporting nation for lace, to the amount of two millions annually, instead of being an importing nation to nearly that amount. Permit your memorialists here to draw your Lordships' particular attention to a recapitulation of the exact position of their trade. Extraordinary study, skill, and invention were applied for 40 years to make the first bobbin-net machine; then continued application for 20 years more has been necessary to bring it to its present degree of perfection. The vast amount of capital sunk during the last 20 years in the machinery now employed, is seen in the incontrovertible fact that, out of the 5000 bobbin-net machines now employed in the English trade, the 3500 machines first constructed, at a cost of two millions sterling, have, by improvements alone, been reduced to the value of 200,000*l.*, leaving the English trade minus 1,800,000*l.* If continental nations succeeded in obtaining a sufficient number of our improved machines to supply themselves, which is their present effort and design, no part of the outlay in invention and improvement can ever be regained; and your Lordships will perceive the jeopardy in which these continental rival manufactories will place our trade, in which 2,000,000*l.* is still invested in capital, and 2,500,000*l.* is paid yearly in wages to between 150,000 and 200,000 persons."

* * * * *

Until the discovery of the bobbin-net machine, all lace was made by an appended machinery to the stocking frame. Sixteen descriptions of bobbin-net machines were attempted (and some of them brought to work) previous to Mr. Heathcote's patent in 1839.

An analysis of the whole of the inventions in lace machinery gives the following results:—

Inventions, previous to Heathcote's patent, for making bobbin-net,	16
Inventions on the double-tier principle,	57
Inventions on the traverse-warp principle,	11
Inventions on the pusher principle,	16
Inventions on Levers's principle,	28
Inventions to make fender-net, called loop-net,	3
Inventions to make foreign cushion-net by machinery,	6
Inventions on the double set of carriage principle,	4
	121

The number of inventions in warp lace is not quite so numerous, but they are equally important.

The invention of the thread-carrier, in 1789, more than doubled the speed of the loom and the stocking frame, and is regarded as the foundation of the fly-shuttle and other momentous improvements in manufacturing skill.

The following are modes of work of fabricating lace and frame-work knitted manufactures, introduced from foreign states:—

1. Round-fingered gloves from Madrid in Spain.
2. Tuck-ribs from Lyons in France.
3. Plated plain work from Nismes in France.
4. Figured warp shawls, the colors worked in on the frame, as practised by Messrs. Hames, at Melbourn. From Lyons.
5. Figured-warp handkerchiefs in various devices, by open works, &c. Lyons.
6. Porcupine point-net scarfs. Troyes and Lyons.
7. Sandal open work plain silk shammies. Paris and Troyes.
8. Knotted hose without seam. Lyons and Barcelona.
9. Round feet in hose. France and Spain.
10. Figured-tied silk stockings. Now obsolete. France.
11. Chevening by hand. France.
12. Chevening in gold and silver, as well as silk, on the frame. Lost. From Cordova and Seville in Spain. The trade has now nearly left those places, and has removed to Barcelona, Valencia, Madrid, and Talavera de la Reyna.

The following are inventions used by foreign states, unknown, or at least not practised in these kingdoms:—

1. Pin machine for making point-net. Lost to the English. France.
2. Trico Berlin machine for making lace in stripes, and to represent feathered work. France, Prussia, Saxony.
3. Cylinder-warp machine to flower the net on the frame. France.
4. Cylinder-tickler machine for making fancy net-hose. France.
5. Machine for working plain stocking-work in colored figures, the same as knit, by using a number of colored bobbins, so as to make a representation of flowers, &c. Barcelona and Turin.
6. Machine for making a sort of Brussels lace in the plain silk stocking. Valencia in Spain.
7. *Metier au Griffre*, or frame on two trucks, having no half-jack, and only a top cramp on jack-springs. France.
8. Revolving slur-wheel stocking frame, which forces down the

jacks without a slur-cock, for cold countries where jacks would not fall. Denmark, Russia, United States of America.

In the preceding enumeration of the various inventions that have been made from time to time, it has been shown that the lace trade has emanated from the stocking-frame, as well as the hosiery trade; I have not therefore attempted to dissever the connexion existing between them (which locality seems also to aid in perpetuating) by separate descriptions of the improved machinery which now relates exclusively to the one or to the other. Those familiar with either trade will at once discover, and be enabled to make the distinction. It is, however, I think manifest that the popular opinion that the stocking frame has received no improvement since its first formation is erroneous, and that time has introduced into this machine many important and salutary amendments. Its peculiar characteristic of having escaped the propelling and invincible power of steam, to which even the winds and the waves may be said to have been constrained to submit, has been ascribed to the fact that the varied movements of the body, hands, and legs, which are each called into action in the working of a stocking frame, are all necessarily mainly regulated and guided by the eye. In the finer work especially, the tax upon this organ is often of great severity, which is shown by the number of middle-aged men who are found using spectacles when at work; and confirmed still further by the fact that, as age advances on the operative, he is invariably found receding from the work of the finer to the coarser gauged frames, long before bodily decrepitude would necessitate the change.

Other and totally different causes may have contributed to discourage any attempt to apply mechanical power to the stocking frame. If all obstacles to a correct and properly made article of hosiery by such means could be overcome, it is doubtful whether, in a pecuniary point of view, it would be a measure of economy in the employers to adopt it. While wages remain, as they have done for years past, almost at the minimum of existence to the workman; while custom sanctions, and his defenceless poverty forces him to submit to pay an exorbitant and disproportionate weekly rent for the machine in which he works; while the mode of constructing the business remains in force, which actually prescribes the very limits of the labor he shall perform, as subsequently shown in the practice of stinting; and while at any time the employer can at little sacrifice to himself lay down his one, his ten, or his hundred frames,—even the rental of the places in which they stand, when at work, being paid by the workmen, there must be great advantages clearly manifested as derivable from any new system of production, which shall preponderate over those yielded by the present one. Lond. Mech. Mag.

Application of Electricity in the Extraction of Metals.

At a recent meeting of the Society of Arts, Mr. Whishaw (secretary) read a paper, by Mr. Napier, "On Separating Metals from their Ores

by means of Electricity." The author's mode of operation is as follows:—He uses a blacklead crucible, lined inside, within an inch or two of the bottom, with a coating of fire-clay, which is allowed to dry, and a second and third coat superadded; the ore to be operated on (which, if a sulphate, should be previously roasted) is put into the crucible, together with a little lime or other flux for the purpose of giving it fluidity. The crucible, with its contents, is then placed in a common crucible furnace; a battery of zinc and copper is prepared with five pair of plates, excited by very dilute sulphuric acid; to the zinc of this battery is attached an iron rod, the end of which is inserted in the furnace, and caused to touch the outside of the crucible; another rod, either of iron or copper, is used, having at one extremity a disk of iron or coke, which is made to rest on the surface of the fused mass in the crucible. The electricity is thus passed down through the whole fluid mass in the crucible, and in the course of an hour the metal is separated from the ore and deposited at the bottom. Ibid.

Submarine Currents.

M. Arago presented to the Academy of Sciences, Paris, in the name of M. Aimè, two instruments, one to ascertain the direction of submarine currents, the other to measure their speed. These instruments were accompanied by an account of several experiments which had been made with them: it states, amongst other things, that the greatest speed of the currents on the coasts is on the coast of Africa, between Algiers and Bona, and not, as is generally supposed, between Gibraltar and Algiers, and that in the Straits of Gibraltar there are three parallel currents. Near the coasts the direction is from east to west, whereas the central current proceeds constantly from the west to the east; the latter is seven miles wide between Trafalgar and Cape Spartel. The width of the strait, at its narrowest part, is twelve miles; between Trafalgar and Cape Spartel it is twenty-seven miles; and fifteen miles between the Point of Europe and Ceuta.

Lond. Mining Jour.

Quantity of Coals, Cinders, and Culm, shipped at the several Ports of Great Britain, during the years 1843 *and* 1844.

A return, moved for by Mr. Vivian, M. P., shows that the total quantities of coals, cinders, and culm, shipped at the several ports of the United Kingdom coastways to other ports of the United Kingdom, amounted altogether in 1843 to 7,447,084 tons, of which 7,138,107 were coals; and in 1844, to 7,377,862 tons, of which 7,017,113 were coals. The quantities exported to foreign countries amounted in 1843 to 1,866,211 tons of which 1,367,925 tons were large, and 452,356 small coals. The declared value of the whole amounted to 690,424*l*. The large coals were chiefly exported to Russia, Denmark, Prussia, Germany, Holland, and France, the United States of America, the British West Indies, and Brazil. France alone took 358,874 tons of large coal, and 99,720 of small coal. The quantities exported in 1844

amounted to 1,289,957 tons of large, and 408,424 tons of small coal, the declared value of all the coals, cinders, and culm being, 672,056*l.* The total amount of duties received on the coals exported in 1844 appears to have been 118,493*l.*—viz., 76,095*l.* on those exported in British, and 40,708*l.* on those exported in foreign ships entitled to the privileges conferred by treaties of reciprocity. The rates of duty were, on coals exported in British ships to foreign countries, 2*s.* per ton, and in foreign ships 4*s.* per ton. Ibid.

On the Connexion between the Winds of the St. Lawrence and the Movements of the Barometer. By W. Kelly, M. D., Surgeon R. N., *attached to the Naval Surveying Party on the River St. Lawrence.*

The author adduces a great number of observations, which are in opposition to the generally received opinion, that the mercury in the barometer has always a tendency to fall when the wind is strong, During a period of fifteen years passed in the Gulf and River St. Lawrence, he found that the barometer as frequently rises as falls under the prevalence of a strong wind; and that the winds often blew with a greater force with a rising than with a falling barometer. He gives a circumstantial account of the progress and course of various gales which came under his observation during that period, and from which he infers the existence of a steady connexion between the prevailing winds of this region and the movements of the barometer, and enters into an inquiry into the mode in which that instrument is affected by them. The extensive valley of the St. Lawrence is bounded at its lower part, for a distance of nearly 500 miles, by ranges of hills, rising on each side to a considerable elevation. Within this space the ordinary winds follow the course of the river: and in almost every instance where they approach from windward, the barometer rises with them; and when, on the other hand, the wind approaches from leeward, the barometer not only falls before the arrival of the wind, but continues to fall until it has subsided. An appendix is subjoined, containing extracts from the tabular register of the barometer and winds at various points in the valley of the St. Lawrence, during the years 1834 and 1835, accompanied by remarks on different points deserving notice in particular cases.—*Proceed. Royal Soc.* London Athenæum.

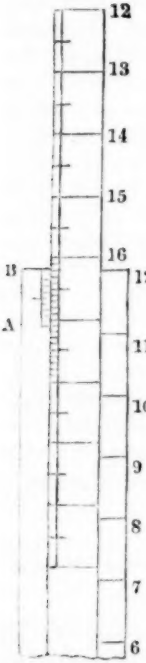
On the Elliptic Polarization of Light by Reflexion from Metallic Surfaces. By the Rev. Baden Powell.

In a former paper, published in the Philosophical Transactions for 1843, the author gave an account of the observations he had made on the phenomena of elliptic polarization by reflexion from certain metallic surfaces, but with reference only to one class of comparative results. He has since pursued the inquiry into other relations besides those at first contemplated; and the present paper is devoted to the

details of these new observations, obtained by varying the inclination of the incident rays and the position of the plane of analyzation, and by employing different metals as the reflecting surfaces. By the application of the undulatory theory of light to the circumstances of the experiments and the resulting phenomena, the law of metallic retardation is made the subject of analytic investigation. A polariscope of peculiar construction, of which a description is given at the conclusion of the paper, was employed in the experiments; and tables are subjoined of the numerical results of the observations. Ibid.

Vernier Slide-Rule for taking Exact Measurements.

Sir.—Having had occasion to make some measurements with minute accuracy in circumstances where a common rule could not be conveniently applied, and not finding in the tool-shops any modification of it that suited my purpose, I contrived one for myself; and as it appears to me to be a great improvement on those in common use, I subjoin a sketch, not doubting that it will be received with pleasure by many of your readers.



The annexed figure represents a 12 inch rule with a slide—the numbering of the inches on the rule itself running upwards, and those on the slide returning in the opposite direction, so that the extent of interval between the extreme ends when the slide is drawn out, is shown at the intersection of the rule and slide. At the top of the rule, a space, A, B, equal to nine-tenths of an inch is divided into ten equal parts, and thus forms a vernier, enabling us to read off the length to the hundredth of an inch. In the diagram the distance between the ends is above 16·1 inches, and under 16·5 inches, the coincidence of 9 on the vernier with a graduation on the rule, shows it to be 16·19 inches. The degree of minuteness in subdivision can easily be increased at pleasure to any extent that the accuracy of the workmanship and the nicety of the observations may render desirable.

The principle can be readily applied to any form of rule and seems particularly well suited for measuring the internal diameter of a tube or cylinder. The length of a line is thus determined not by the application of the thumb-nail or the scratch of a piece of iron or other such rude method, but by the coincidence of the divisions of the scale itself, and is thus evidently susceptible of much greater precision.

This kind of rule is so simple and so much superior to those in common use; its principle is, moreover, so obvious, that I was very much surprised to find none such already constructed. A vernier usually slides upon a scale, and here the scale slides upon the vernier; this inversion of their relative positions is the only novelty in the present arrangement.

A rod with a slide in it and graduated like this rule, would, I think, be an improvement in the poles used for leveling; the sights might then be directed, not to a graduation on the pole, but to a fixed object on the slide, specially designed for that purpose, and which might be elevated or depressed at pleasure, by a racked wheel, and its height seen by the intersection of the rod and its slide.

Glasgow Prac. Mec. & Eng. Mag.

On the Advantages of working Engines with High-pressure Steam expansively, and at great Velocities. By J. G. Bodmer.

The author based his observations upon the principle of a considerable area of piston being essential for taking advantage of the initiative impulse of highly elastic steam, in contradistinction to the idea of a percussive action, which had some time ago found advocates.—*Proc. Ins. Civ. Eng.*

London Athenæum.

Siemen's Chronometric Governor.

The action of this governor is so sensitive, that no variation of the speed of an engine, when 40 per cent. of its load is thrown off, can be observed, for the entire change is performed in one-fiftieth of the revolution of the fly-wheel; this change absorbs or adds a portion of the momentum of the pendulum, and slightly alters its arc of vibration, the limit of which is between 18° and 21°; and by the laws of pendulous motion, this is shown to effect the number of revolutions to the amount of only 8 per cent. of its velocity, and even that small variation in the extreme position of the pendulum ceases immediately the momentum is restored to its former condition. Ibid.

Description of Rowan's Churn, as Manufactured by Mr. Richard Robinson, *Lisburn.*

Fig. 1 represents the entire churn when set up for work: it consists of an oval-shaped vessel, divided, in the direction of its longest diameter, into two compartments; in one of which the paddle-wheel works: in the other the butter is collected, as will be better understood by fig. 2, which is a section of it, viewed from above when the cover of the wheel is removed. By turning the paddle wheel (which resembles the one used in the old box-churn) a current of the milk is maintained in the direction of the arrows. As soon as the butter collects on the top of the milk, it is borne along with the current; and by sliding down the sluice (*a*) to the surface of the milk, the butter is intercepted, and accumulates on one side of the sluice; it is then taken out with a small tin scoop, pierced with small holes, through which any milk may pass; but perhaps the accompanying description which

is sent with each churn will tend to explain it better than anything I can write:—

Fig. 1.

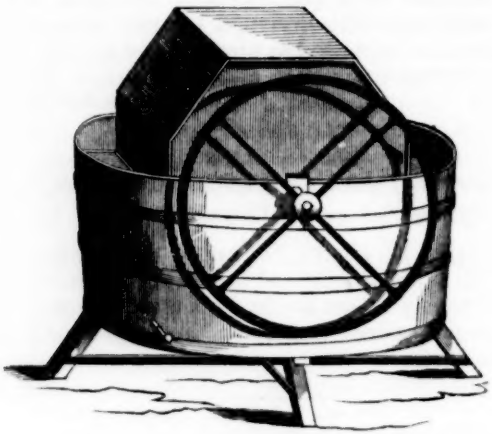
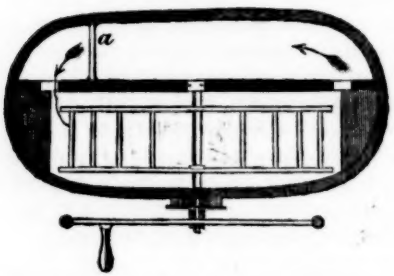


Fig. 2.



"This machine possesses decided advantages over every other hitherto in use, inasmuch as it is more easily worked, and produces more butter of a better quality, than that obtained from, or by, any other churn. As to the superior quality of the butter obtained, it arises partly from the low temperature at which the operation can be performed; for while in other close machines the temperature rises during the operation, in this, the fluid being exposed to the current of air created, the temperature is found to be lower at the latter end than at the beginning of the process; besides, the butter is not so much beaten and toughened by repeatedly passing under the blades as in other machines. It is found, therefore, from all these causes united, that the quality and quantity of the butter are improved, and the labor decidedly lessened. In using a thermometer, this machine possesses superior convenience for making a true observation of the temperature; for, in other machines, the process must be stopped to try the heat; in this, the thermometer may be suspended constantly in the smaller division of the churn, and the temperature accurately observed, at any time, whilst the process of churning is going on.

"The large churns are made, in a most substantial manner, of oak and sycamore, being the best sorts of timber known for the purpose. The smaller sizes are made of strong block tin, with a separate water-case stand, so that all the advantages of the celebrated water-case churns are combined in this new and effective machine.

"The following table is submitted as being convenient for determining the size of churns to be ordered:

Number of cows kept, averaging ten quarts daily.	Quantity of milk collected in two days.	If reduced to cream only.	Size of churn required for Milk, using it every two days.	Size required for cream using it every two days.
	quarts.	quarts.	gallons.	gallons.
1	20	2½	8	8
2	40	5	15	—
3	60	7½	24	—
4	80	10	—	—
5	100	12½	30	—
6	120	15	—	—
7	140	17½	36	—
8	160	20	42	—
9	180	22½	48	—
10	200	25	54	15
11	220	27½	60	—
12	240	30	60	—

"This table is only offered as a guide to the sizes of churns requisite, not as containing information on any other point; for quantities of cream or milk will vary much, according to food and management, &c. It is better, however, to order the churns too large than too small."

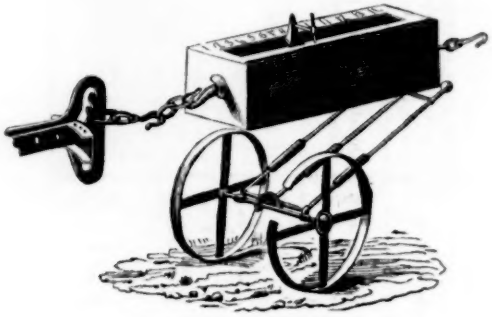
Although good workmanship and neatness of finish is an important feature in every well constructed implement, yet in no department is this more necessary than in those utensils intended for the dairy.

Lond. Farm. Mag.

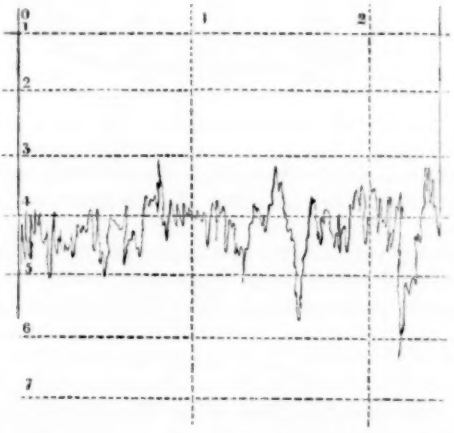
Clyburn's Self-Recording Dynamometer.

The appearance of Clyburn's Dynamometer, as our engraving shows, is that of a small box on wheels. Within the box are a right and left hand spiral spring, placed within each other for economizing space. When the power is applied, the springs are compressed: whilst being compressed, motion is given to a rack and pinion; and, by a simple mechanical connection, motion from the rack and pinion is communicated to a traversing pencil upon the top of the box; the pencil there acts upon a roll of paper, marked with lineal divisions,

both lengthways and crossways, each division in the length of the paper indicating a distance of twenty-five yards of ground passed over, and each division of the width 112 pounds of force applied to the instrument. Motion is given to the paper by the pair of wheels which travel over the ground, whilst the pencil is moved backwards and forwards according to the amount of power applied, and thus a drawing is made upon the paper, showing the draught, and the distance traveled over.



The subjoined diagram will describe the nature of the drawing made by the pencil.



The figures down the side, from 0 to 7, represent cwts.; those on the top, distances of twenty-five yards; from which it will be seen that, according to the drawing, the force applied in draught during the fifty yards, averaged rather more than 4 cwt.; because the intersecting line from 4 shows more of the drawing towards the line 5, than it does towards that of the line 3. Ibid.